GenRad

# 2511/2514
# VIBRATION
# CONTROL SYSTEMS

## SYSTEM DESCRIPTION MANUAL

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# CHAPTER 1

# DESCRIPTION AND GENERAL INFORMATION

## 1.1 INTRODUCTION

### 1.1.1 Purpose

The GenRad 2511 and 2514 Vibration Control Systems (VCS) are designed primarily for closed loop operation of vibration testing and shaker control. For this application the principal operating software is the GenRad RANDOM software package.

Being computer-based and software-controlled, the 2511/2514 Systems can also be used in general signal analysis applications with other software packages. The major ones are listed and summarized below. Since the functions of the Systesm depend on the software package that is loaded, the detailed operation of each of these application program packages is described in the separate, individual operating manuals listed in paragraph 1.1.3.

The 2514 System includes many of the 2511 hardware options packaged as a standard system.

### 1.1.2 Scope

This manual is intended to provide a general introduction to the System's hardware components, and to the hardware controls, indicators, connectors, and operating characteristics that are applicable to any of the software packages.

The various application software manuals assume that you are familiar with the general information herein. Chapters 1 and 2 provide functional and physical descriptions of the System's major components and Chapter 3 describes the hardware operations that will be used by operators.

Furthermore, all of these application software packages run under control of the Digital Equipment Corporation RT-11 single user operating system

It is not necessary to deal directly with the RT-11 system to run an application package. In fact, the only operating instructions you initially need from this manual are the startup procedure summarized in the following Condensed Operating Instructions. However, after the System has been in use, you will need the RT-11 utility functions for management of your program and data files stored on disks. Section III introduces RT-11 operations with a detailed step-by-step procedure for duplicating disks. This procedure will also be helpful in understanding general system operation for the use of application programs under RT-11. Chapter 4 goes on to describe all the functions of RT-11 that are available from the software supplied.

### 1.1.3 Software and Related Manuals

The application software packages offered for the 2511/2514 Systems, and their operating manuals, are:

RANDOM Random Vibration Control Package (Operating Manual 2511-0120). RANDOM performs real time closed loop shaker control for environmental test specifications such as MIL-STD-810 and -781. Program features include true random signals and operator selectable resolution. On line displays of drive, control, reference, error and transmissibility functions are all fully annotated and can be changed by the operator during testing.

SHOCK Shock Waveform Synthesis, Control and Analysis Program (Operating Manual 2511-0140). Optional. The SHOCK Program can be used to generate a variety of transient excitation signals. In addition to half sine waveforms, other waveforms which can be synthesized in terms of rise time, duration and fall time (trapezoids, rectangular, sawtooth, etc.) can be specified to create a desired shock pulse. A reference shock response spectrum can also be converted to a shock waveform using a summation of damped sinusoidal components. The synthesized waveform can then be used to drive a shaker and subject the test article to the specified impulse load.

SINE Sinusoidal Vibration Control Package (Operating Manual 2511-0130). Optional. SINE provides multichannel, multi-strategy control for performing a variety of swept-sine vibration tests. Since control for swept sine testing equalizes sharp resonances without needing to modify the sweep rate. Compression speeds (error correction rates) are selectable. The reference spectrum can be defined in terms of acceleration, constant velocity and constant displacement segments. These features, together with high dynamic range and frequency resolution, enable the 2511/2514 systems to compensate practically all resonances encountered in the device under test. In addition, transfer functions between any two input channels can be displayed or stored or disk for later recall and display.

ISAP Interactive Signal Analysis Package (Operating Manual 2501-0150). Optional on 2511, standard on 2514. ISAP is a menu-driven, fast, on-line program for general signal analysis operations. Its functions include measurement of auto and cross spectra, auto and cross correlation functions, amplitude probability density, time domain waveform averaging, and transfer function computations for amplitude and phase frequency response, impulse response, and coherence function. ISAP can store frequency response results in disk files that are compatible with MODAL. ISAP can produce frequency response functions with considerably better frequency resolution than MODAL (in one pass).

TSL — Time Series Language (Programming Manual 2501-0110). Optional. TSL is an exclusive GenRad programming language for time series and signal analysis applications. TSL is similar to the widely used BASIC language in structure, but is specifically designed for array manipulations and Fourier spectrum computations, and is particularly useful in repetitive or highly complex signal processing.

MODAL — Modal Analysis Package (Operating Manual 2501-0100). Optional. The MODAL package performs vibrational mode surveys of mechanical structures, providing for pictorial definition and representation of the structure, data acquisition and determination of frequency response functions between defined locations, computation of the frequency, phase, damping, residue magnitude parameters of the vibration modes, and animated displays of the mode shapes.

## 1.2 CONDENSED OPERATING INSTRUCTIONS

Starting an application program, such as ISAP, is usually a simple matter of inserting the appropriate software diskette in the drive, setting the power switch ON, and entering a date when requested in a brief startup dialog. For standard software, as distributed, all other startup functions are automatic. The following procedure provides some additional notes on these functions for certain unusual conditions. The procedure is described in further detail in Section III, including the relationship of the operating system and the application program, and the internal operations that are performed:

Step 1. Insert the application package diskette (which includes the necessary parts of the RT-11 system) into floppy drive Ø and snap the cover door closed.

Step 2. Set the power rocker switch ON and press the BOOT/HALT toggle switch up toward BOOT to start the sequence. The system will display the prompt DEV> (or AED>) after the BOOT/HALT switch is pressed towards BOOT. To boot drive DY0: enter any of the following commands, DY(CR), or DY0(CR). To boot drive DY1: enter DY1(CR). To boot logical unit DL0: of the Winchester, enter DL(CR) or DL0(CR) or press the RETURN key. To boot logical unit DL1: of the Winchester enter DL1(CR).

NOTES

Do not press the BOOT/HALT switch down toward HALT. The HALT function is for maintenance purposes only. It sets the controller into a halt mode and starts a built-in debugger that will print a 6-digit number and an @ sign. If this happens, reboot the system.

If the System was previously shut down in a certain indeterminate condition, the automatic power-up boot may not occur and the display screen may fill with a random pattern. If this happens, just press the switch to BOOT and immediately press the ERASE key. The ERASE key will not function until the initial BOOT signal occurs.

Step 3. Standard software packages contain a startup command file that performs certain initializing functions and requests entry of date and time. The startup file will print some messages similar to the ones below, but this may vary somewhat from one package to another. The date entry, in the form dd-mm-yy, is required. The time, in the form hh:mm:ss, is optional. All operator entries are underscored and must be terminated by the carriage RETURN key (CR):

```
RT11SJ (S) V05.00  Monitor identifies itself.

SET TT SCOPE       Sets system for video type display.
SYSINT             Initializes analog input hardware and
                   requests date and time.

PLEASE ENTER TODAY'S DATE: 1-SEP-81 (CR)
PLEASE ENTER THE TIME: 13:20:00 (CR)

R RANDOM           Starts application program.
```

Step 4. The last command loads and starts an application program, which will identify itself in some way such as drawing a plot or presenting a menu. At this point, you are ready to go to the appropriate application package software manual for further operations.

NOTE

When original program disks are first received you should make security backup duplicate copies before using them. Section III gives a detailed procedure for using RT-11 to make copies.

## 1.3 SPECIFICATIONS

Table 1-1 lists the specification for the 2511 and 2514 systems.

## 1.4 ACCESSORIES AND OPTIONS

Table 1-2 lists the accessories and options available for the 2511/2514 systems at the time of printing.

TABLE 1-1. Features, Characteristics, and Specifications

| Characteristics | Specification | | | |
|---|---|---|---|---|
| **SYSTEM SIZE AND WEIGHT** | Width | Depth | Height | Weight |
| Keyboard: | 18 in (45.7 cm) | 7.5 in (19 cm) | 1.5 in (3.8 cm) | 33 lbs nominal (14.9 kg) |
| CRT: | 18 in (45.7 cm) | 12.5 in (31.8 cm) | 12. in (30.5 cm) | |
| Rack Mount Chassis: | 16.75 in (42.6 cm) | 11.0 in (27.9 cm) | 5.75 in (14.6 cm) | 29 lbs (13.15 kg) |
| VCS Box: | 19.7 in (50 cm) | 11.5 in (29 cm) | 26 in (66 cm) | 85 lbs (38.5 kg) |
| **SYSTEM POWER REQUIREMENTS** | | | | |
| Service: | Single-phase, 3 wire, 30 A | | | |
| Power: | 850 watts 115 V, aproximately 15 A<br>230 V, approximately 6 A | | | |
| Frequency: | 60 Hz<br>50 Hz | | | |
| **SYSTEM ENVIRONMENT** | | | | |
| Temperature: | 10 to 50 deg C (50 to 122 deg F) | | | |
| Humidity: | 8 to 80 percent, non-condensing | | | |
| Maximum Thermal Gradient: | 15 deg F per hour. | | | |
| **ANALOG INPUT SPECIFICATIONS** | | | | |
| Input: | Single-ended (BNC connectors) 10 ohm to system ground low side return | | | |
| Number of Input Channels: | One standard on 2511, two standard on 2514, up to four optional | | | |
| Maximum Input Frequency Range: | DC to 25 kHz with anti-alias protection on all channels | | | |
| Impedance: | 1M ohm shunted by < 100 pf | | | |

TABLE 1-1. Features, Characteristics, and Specifications (Continued)

| Characteristics | Specification |
|---|---|
| Full Scale (FS) Ranges: | .125, .25, .5, 1.0, 2.0, 4.0, 8.0, 10.0 V peak |
| Auto Ranging: | Selectable for all channels |
| Gain Accuracy: | ±.5% |
| Max Input (operating): | ±10 V (protected to ±30 V) |
| Input Coupling: | dc or ac (-3 dB at 1 Hz) |
| DC Offset: | Auto zeroing to ±.5% FS |
| Harmonic Distortion: | <.1% (60 dB down from FS) on 1 volt or less FS ranges |
| Crosstalk Between Channels: | >60 dB isolation between channels with input signals that are within selected input ranges |
| Overall Noise Level: | >60 dB down all ranges |
| Overload Detection: | On converted (digital) value |
| Throughput (at 2.56:1 oversampling): | Max bandwidth / 25 kHz — Number of channels / 4 or less |
| **ANTI-ALIAS FILTERS** | |
| Type: | Cascaded 6 pole Chebyshevs |
| Cutoff Frequencies ($f_c$): | 75 selectable cutoff frequencies for each channel |
| Alias Protection: | >70 dB down with 2.56:1 oversampling |
| Filter Ripple: | ±.5dB, 0 to .9 $f_c$ |
| Phase Matching: | ±5° between channels 0 to .9 $f_c$ ±10° @ $f_c$ |
| Attenuation at $f_c$: | -1 dB |
| Cutoff Frequency Accuracy: | -1%, +.5% |
| Rolloff: | 72 dB/octave |
| **SAMPLING** | |
| Modes: | Internal or external |
| External Clock Input: | TTL level, "0" true, 100 ns min pulse duration |
| Internal Rates: | $fs = \frac{clock}{nx10^k}$, clock = 4.0 MHz "time" / 4.096 MHz "freq"<br>k = 0, 1, 2<br>n = 1,2,3, . . . 4095, 4096 |
| Max Sampling Rate: | $fs\ max = \frac{10^6}{4.1\ \mu s + L \times 2.9\ \mu s}$<br>L = number of channels being utilized |
| Multichannel sampling interval: | Simultaneous sampling on all channels |
| Acquisition Time: | 4-5 μs simultaneous on all channels |
| Aperture Uncertainty: | ±5 ns |

TABLE 1-1. Features, Characteristics, and Specifications (Continued)

| Characteristics | Specification |
|---|---|
| **CONVERSION CHARACTERISTICS** | |
| Number of Bits: | 12 |
| Conversion Time: | 2 μs + .9 μs +multiplexer setting |
| Data Output Mode: | Direct memory access (DMA) transfer |
| Buffering: | Automatic double buffering for up to eight channels (4 max in 2511/2514) |
| Demultiplexing: | Automatic into n buffers (2n for double buffering) when n is the number of channels being sampled |
| Frame Size per Channel: | 128 to 16K in a binary sequence. Frame size doubles for zero insertion. |
| **TRIGGER** | |
| Source: | Channel 1, 2, 3 external, digital or free run |
| Slope/Threshold: | +,- slope, -FS to +FS in 64 steps |
| External Input: | ±2 volt range, dc coupled |
| Threshold Accuracy: | ±5% FS |
| **DIGITAL OUTPUT SPECIFICATIONS** | |
| Number of Output Channels: | One |
| Output Impedance: | 50 ohms |
| Digital to Analog Converter: | 12-bit resolution, ±10 volt maximum output. |
| Output Bandwidths | 200, 500, 1000, 2000, 3000, 4000, 8000 Hz. |
| SPECTRAL RESOLUTION | Selectable for 100, 200, 400, or 800 lines with Random package. |
| DATA STORAGE | Mini-floppy disk drive, total capacity, .5 megabytes per mini-floppy. Optional 20 megabyte Winchester drive (standard on 2514). |

TABLE 1-2. ACCESSORIES AND OPTIONS

| Option | Part | Function |
|---|---|---|
| Thermal Printer: | 2510-9400 | Operates in conjunction with the terminal and display controller to provide hard copy records of the video display. |
| Printer Paper: | 2501-9424 or 8433-7007 | By the case (24 rolls). By the single roll. |
| Printer Heads: | 1762-3533 | N/A |
| One Additional Input Channel: | 2511-9400 | Converts the 2511 system into a two channel system for faster data collection and provides multi-channel control strategies. |
| Two Additional Input Channels: | 2511-9530 | Converts the two channel 2511 and 2514 systems into four channel system for faster data collection and provides multi-channel control strategies. |
| Memory Card, 128K words: | 2511-9418 | Provides the 2511 system with 128K words of memory. Note that the system may contain either the 32K word memory board or the 64K word memory board but not both. (Standard on 2514.) |
| RS232 Interface: | 2511-9401 | Allows the 2511/2514 systems to communicate with the Tektronix 4662 digital plotter. |
| Tektronix 4662 Digital Plotter: | 2511-9405 | Operates in conjunction with the terminal and display controller to provide hard copy records of the video display. |
| Remote Communication Interface: | 2511-9404: | Provides the 2511/2514 systems with remote control capability for use with such remote devices as environmental test chambers or other computers. Random tests can be executed through the interface allowing start, stop, hold and continue functions. |

TABLE 1-2. ACCESSORIES AND OPTIONS (Continued)

| Option | Part | Function |
|---|---|---|
| 16 Channel Selector: | 2511-9403 | Allows the Random program to acquire input data from up to 16 input channels. |
| Winchester Disk: | 2511-9429 | Provides an additional 20 Megabyte of data storage (standard on 2514). |
| High Performance Controller: | 2511-9433 | Provides quicker processing times (standard on 2514). |
| Rack & Pedestal: | 2511-9414 | Allows the 2511/2514 to be rack mounted. |

## 1.5 PHYSICAL AND FUNCTIONAL DESCRIPTION

The major physical components of the 2511/2514 systems, as shown in figure 1-1, are (1) a keyboard for operator input, (2) a raster scan CRT display unit for echo of operator inputs and printouts and data plots from analysis operations, (3) an optional thermal printer for making hard copies of the displays, (4) two mini-floppy disk drives for program and data storage, (5) the system mounting box, and (6) the Winchester disk drive.

Within the System, there are two circuit board connector backplanes, on which are mounted the following major functional components: (a) a Digital Equipment Corporation (DEC) LSI-11 microcomputer, which serves as the general system controller, (b) system memory and an interface to the mini-floppy disk, which are associated with the LSI-11, (c) a GenRad 2501 microprocessor, which provides special purpose high speed arithmetic and processing functions, and the interface to the keyboard and display, and (d) the GenRad ADS Analog-to-Digital Subsystem, which performs the sampling, a-d conversion, and storage functions for analog signal data acquisition. (e) The GenRad Q-DAS Q-bus Digital-to-Analog subsystem, which performs digital to analog conversion and provides the analog drive signal used to drive the shaker tables.

The functional relationship of these components and some of their more significant internal parts is shown in figure 1-2. The various application software manuals may refer to these hardware components and some knowledge of their functions and operating characteristics will be helpful in using the application programs.

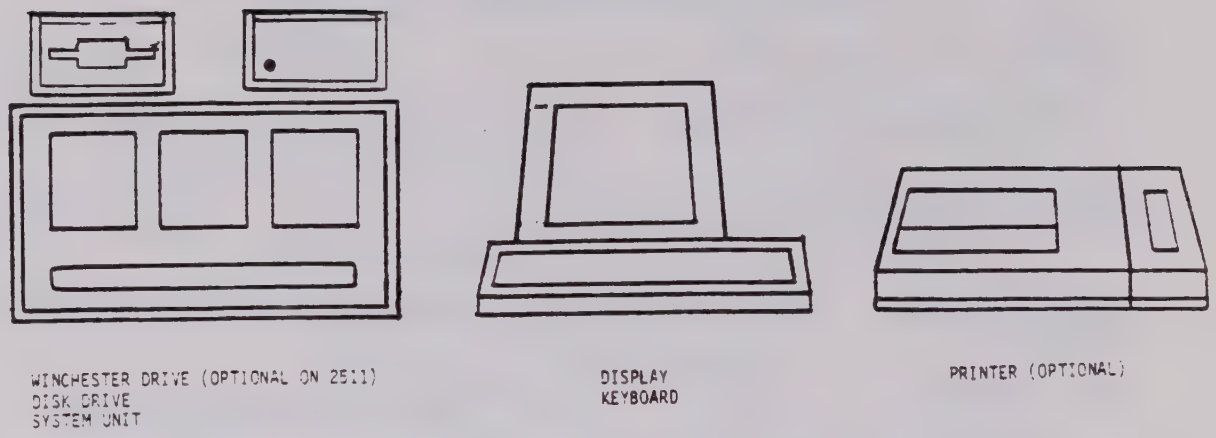



Figure 1-1. Typical System Configuration

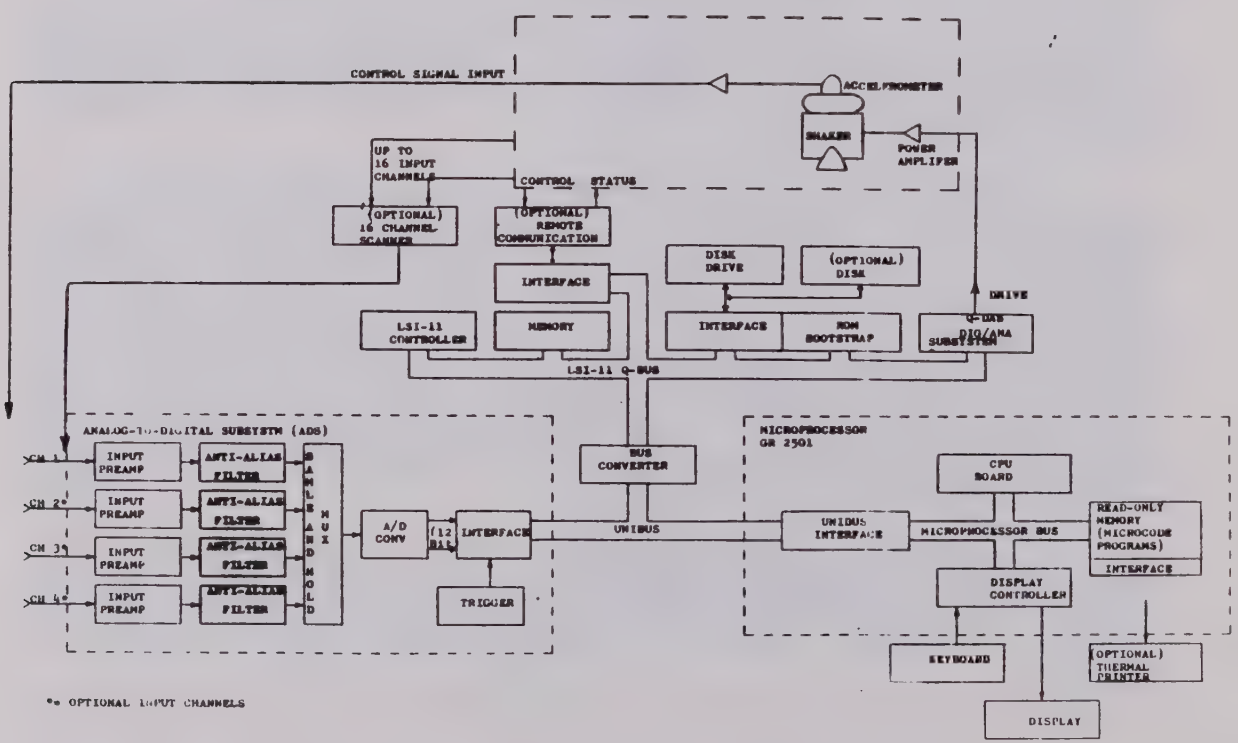



Figure 1-2. Functional Block Diagram

### 1.5.1 System Controller

The LSI-11/23 is the controller for the system. The RT-11 operating system and the GenRad applications programs run in the LSI-11. The LSI-11 basically controls the Q-bus and arbitrates use of the bus by other connected devices. There is only one operator function directly involved with the LSI-11 and that is the BOOT operation to load and start the system programs. The System has 64K (or 128K) 16-bit words of memory standard.

### 1.5.2 Bus Structure

The bus structure is the common link for data transfer between all components in the system. All devices interfaced to the bus structure have direct memory access (DMA) capability. This means that once a device has been granted access to the bus structure, that device can transfer data to and from memory or other devices. This data transfer can be done without attention from the LSI-11. The bus structure is made up of the Q-bus, the Unibus, and the bus converter board.

### 1.5.3 Deleted

### 1.5.4 Disk Storage

The floppy disk drive provides on-line storage for various operating programs, application programs, and data files. The removable floppy disks provide extensive off-line storage of data files, test records, and additional programs. On-line storage is approximately .5M bytes per disk. The 20M byte Winchester is available as an option on the 2511 and is standard on the 2514. The disk drives are controlled through an interface circuit board mounted in the System box on the 2501 backplane.

### 1.5.5 Analog-to-Digital Subsystem (ADS)

The ADS provides the analog data acquisition function. It contains five major parts. These parts are all program controlled by the user through the various application programs. The parts are:

A programmable amplifier for each input channel. The amplifier selects the input range and adjusts the input signal level. This is done so that all ranges have the same full scale amplitude at the input to the following filter and analog-to-digital (A/D) stages. Eight ranges are provided from ±125 mV peak to ±10 V peak. This allows preservation of maximum dynamic range for various signal levels.

A programmable low pass anti-aliasing filter for each channel. Aliasing is a phenomenon whereby components in the input signal that have a frequency greater than half the sampling rate will "fold" down into the analysis range. These folded signals erroneously appear to be components of lower frequency within the range. Low pass filtering of the input removes these components before the signal is sampled. Actually, there are two cascaded 6-pole Chebychev filters on each channel. These filters provide rolloff of 96 dB/octave above the cutoff. The cutoff is programmable at approximately 70 frequencies from the lowest range of 10 Hz to the highest of 25 kHz. Together with appropriate combinations of sampling rate, aliased components are kept at least 70 dB down from full scale.

Sampling and Analog to Digital Conversion. The analog input signals are sampled simultaneously and converted to digital words for storage in memory and subsequent digital processing. As noted in the paragraph on anti-alias filters, the signal must be sampled at a rate at least twice the highest frequency component of interest. In most GenRad applications software, sampling is programmed at 2.56 times the desired bandwidth for additional protection against aliasing. This is done because the anti-alias filter is not perfect and has a rolloff curve. Thus, for the maximum filter cutoff setting of 25 kHz, (i.e., bandwidth) sampling is usually programmed at a 64 kHz rate. The ADS unit has a 2 microsecond, 12 bit A/D converter and uses simultaneous sampling. All channels are sampled in parallel. The held samples are multiplexed to the A/D converter and converted sequentially. Sampling at 2.56 times the analysis bandwidth, the ADS can maintain a bandwidth of 25 kHz for up to four channels.

Trigger Circuit. For transient signal investigations, the start of data acquisition can be triggered. The trigger source may be selected from any of the first three analog input channels, from an external analog trigger input, or from an external digital trigger signal represented by a TTL logic level or switch closure input. For the analog sources, positive or negative slopes, or both, may be selected. The level is programmable at 64 steps between the negative and positive full scale levels. These steps are determined by the input amplifier setting except for the external analog trigger input. This input has a fixed range of ±2 V. In conjunction with the control logic, a transient capture mode may be selected. In this mode, the start of acquisition of the input record blocks can be advanced or delayed in time from detection of the specified triggering conditions.

Control and Interface Logic. This final section contains the control registers for programming the conditions in the previously described sections. This section also contains the DMA interface logic for transferring input samples to memory over the Unibus. Included are the word count logic for specified input record sizes, the addressing and sorting logic for generating memory putaway addresses and separating multi-channel input records, and the buffer swapping logic for the double buffer input mode. This mode allows continuous data acquisition while processing is in progress. The control logic section also provides error detection logic for conditions such as illegal range, filter, or sampling rate setups, overranging of the input signal (saturated full-scale A/D output), or loss of an input sample due to bus access problems.

### 1.5.6 Q-Bus Digital to Analog Subsystem (Q-DAS)

The Q-DAS generates an analog output signal which is used to drive shaker tables. The Q-DAS consists of a direct memory access Q-Bus interface for reading digital data blocks from memory, a 12 bit D/A converter, smoothing filters and a programmable attenuator to adjust the final output level of the drive signal.

### 1.5.7 GenRad 2501 Microprocessor

The 2501 microprocessor performs two principal functions through its micro-coded programs:

- It performs high-speed special purpose arithmetic functions such as the Fourier transform algorithms and related spectral processing operations and complex housekeeping and tracking filter functions for vibration control. This is done at much higher speeds than would be possible using LSI-11 software methods.

- It provides the logic functions to receive and translate inputs from the keyboard. It sends the output to drive the video display and the printer.

Physically and functionally, the microprocessor has five major components. The functions of these components are as follows:

- A mounting backplane provides an internal microprocessor bus. This bus is separate and distinct from the Unibus.

- A Unibus interface board provides communication with the other components.

- A PROM (programmable read only memory) board contains the microcoded programs for the microprocessor functions and the drive logic for the printer.

- A CPU board with special purpose arithmetic processing logic.

- A Display controller board provides display character and vector generation logic for the display. In addition, it provides the video driver for the display monitor.

### 1.5.8 Keyboard and Display

The keyboard is a GenRad design for use with several systems and instruments. In addition to the 7-bit ASCII character and command code set, it provides several special 8-bit codes from command keys. These keys and their functions are described in table 1-7 and in Section III.

The display unit is a standard television monitor. It uses a non-interlaced scan with 60 Hz refresh rate (50 Hz in Europe). It is driven by a video generator in the display controller of the microprocessor. The video generator is constantly

reading out a 512 x 256 bit memory in the display controller. This memory contains a dot by dot representation of the picture to be drawn. The picture is written into this memory by the character and vector generation logic in the display controller and transferred to the screen through the video generator.

### 1.5.9 Thermal Printer (Optional)

The thermal printer operates in conjunction with the terminal and display controller to provide hard copy records of the video display. The printer produces a replica of the display screen, either alphanumerics, graphics, or both. The printer can also be operated in a line printer mode for pure alphanumeric data. The printer is controlled from the keyboard and may be operated in a manual mode for one "page" at a time copying. The printer can also be operated in an automatic mode to produce a running record of the display in conjunction with the scrolling feature. In page mode, keyboard commands can also be used to select different sizes and proportions for the copies. The copier modes are described in Section III.

NOTE

The printer is driven through a special GenRad interface. The controls consequently do not operate as described in the Data Products manual supplied with the printer. That manual assumes a standard Data Products interface.

## 1.6 CONTROLS, INDICATORS, AND CONNECTORS

All system operating controls, indicators, and connectors are identified and briefly described in the following tables and figures:

| Table | Component | Figure |
|---|---|---|
| 1-3 | 2511 Unit | 1-5 |
| 1-4 | Disk Drive | N/A |
| 1-5 | Thermal Printer (DPC T-80) | 1-6 |
| 1-6 | Display Monitor | 1-7 |
| 1-7 | Keyboard - Special Function Keys | 1-8 |

## 1.7 16 CHANNEL SELECTOR (Optional)

The optional 16 channel selector provides the 2511/2514 systems with the capability of sampling data from 1 of 16 input signals. All control signal inputs are connected to the selector connectors Ch 1 through Ch 16 (see Figure 1-3). The selector output is then connected to the ADS channel 1 input. The ADS under program control sample data from one input signal at a time. This is accomplished by the closure of miniature dry reed relays selected by compliment bits 0-3 of the Multiplexing Register 764316.

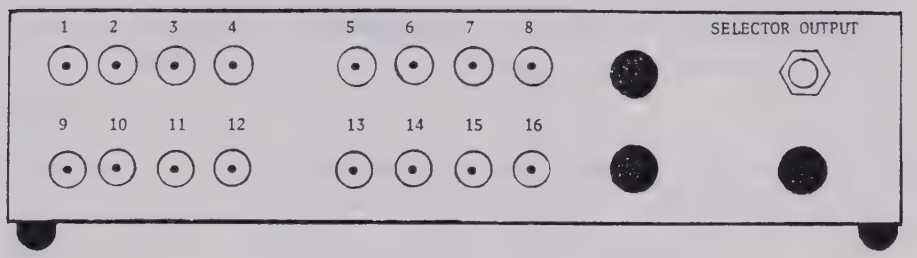



Figure 1-3. 16-Channel Selector

## 1.8 REMOTE COMMUNICATION INTERFACE (Optional)

The Remote Communication Interface provides the 2511/2514 systems with remote control capabilities for use with such remote devices as environmental test chambers. Test schedules can be executed through the interface allowing start, stop, hold and continue functions and allows selection of sequence numbers to run the test in any order. The Remote Communication Interface consists of a plug-in, printed circuit board which mounts on the 2511 backplane (refer to the Remote Communications Interface Installation Procedure, Part #2511-1005 for location) and an external chassis with 16 BNC connectors marked command lines (from Remote) 1-16 and 16 BNC connectors marked status lines (to remote) 1-16 (refer to figure 1-4).

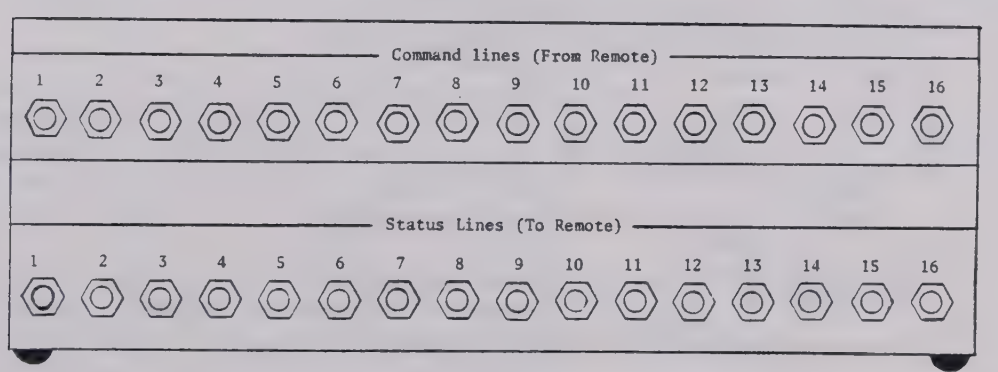
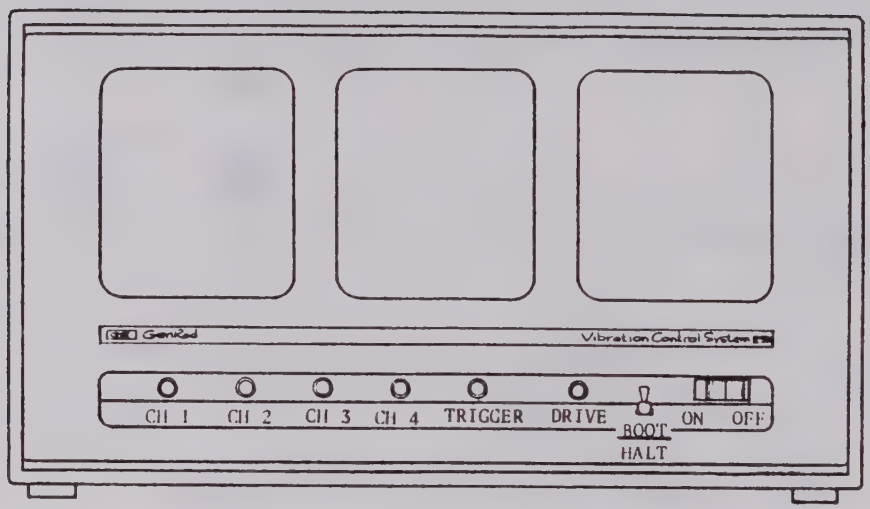



Figure 1-4. Remote Communication Interface Chassis

FRONT




BACK

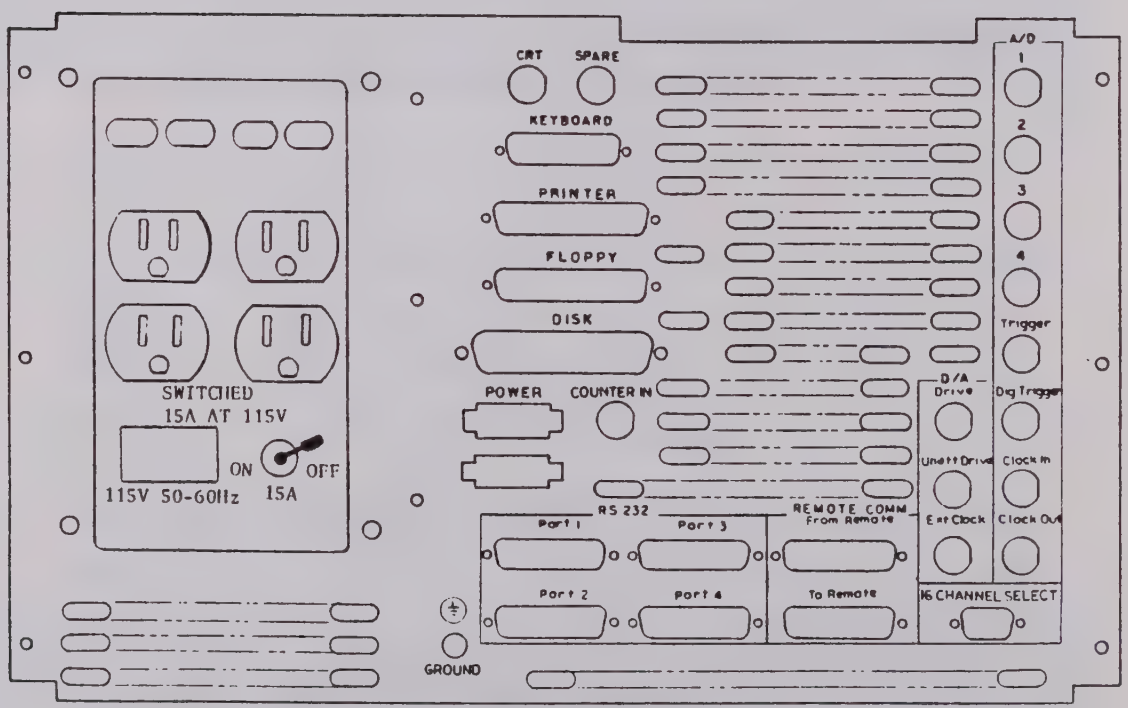



Figure 1-5. 2511/2514 System Unit

Table 1-3. 2511/2514 System Unit

| Item | Function |
|---|---|
| **FRONT PANEL** | |
| Input Channels | One standard on 2511, two standard on 2514, up to four optional. BNC analog input connectors. |
| Input Trigger | BNC input for external trigger. |
| Boot/Halt | BOOT loads and starts sytem programs from disk mounted on lefthand drive #0.<br>HALT halts controller and enters manual debugging mode (for maintenance only). |
| Drive | Analog output from Q-DAS to shaker table. |
| ON/OFF | AC power switch (and automatic BOOT). |
| **BACK PANEL** | |
| Input Channels | BNC input for analog channels (parallel to front panel). |
| Trigger | BNC input for external analog trigger (parallel front). |
| Dig Trig | BNC input for external digital trigger (TTL levels). |
| (ADS) Clock In | BNC input for external sampling clock (TTL levels) |
| (ADS) Clock Out | Sampling clock for sample and hold circuit. TTL level. Derived from internal sampling rate control logic or externally supplied sampling clock. |
| CRT | BNC, video to display unit. |
| Keyboard | Interconnect cable to keyboard. |
| Floppy | Interconnect cable to disk drive. |
| Printer | Interconnect cable to optional thermal printer. |
| 15 A ON/OFF | Main power controller circuit breaker. |

Table 1-3. 2511/2514 System Unit (Continued)

| Item | Function |
|---|---|
| 115 V 50-60 HZ | Main power cord input receptacle. |
| SWITCHED 15 A AT 115 V | Power cord receptacles for display unit, printer, etc. Switched by front panel ON/OFF rocker switch. |
| DISK | Interconnect cable to Winchester disk drive. |
| POWER | DC power for disk drives. |
| COUNTER IN | Input to counter circuit board (if installed). Approx ±15 V max. Use will be described in applicable software operating manuals. |
| (Q-DAS) DRIVE | Analog output signal for shaker drive from Q-DAS final output attenuator. |
| (Q-DAS) UNATT DRIVE | Analog output signal from Q-DAS d/a converter and smoothing filter, before the final output attenuator. |
| (Q-DAS) EXT CLK | Input for externally supplied output sample rate clock. TTL level. Output clock is selected internally by software from this input or from ADS clock input to SYNC IN. |
| RS232 | Optional. Allows the 2511/2514 systems to communicate with digital plotters and other computers via DataLink. |
| REMOTE COMM | Interconnect cables to optional remote communication interface. |
| 16 CHANNEL SELECT | Interconnect cable to optional 16 channel selector. |
| ON/OFF Rear Panel | AC power rocker switch. Normally left ON for switched ac from 2511/2514 unit power controller. |

Table 1-4 Deleted

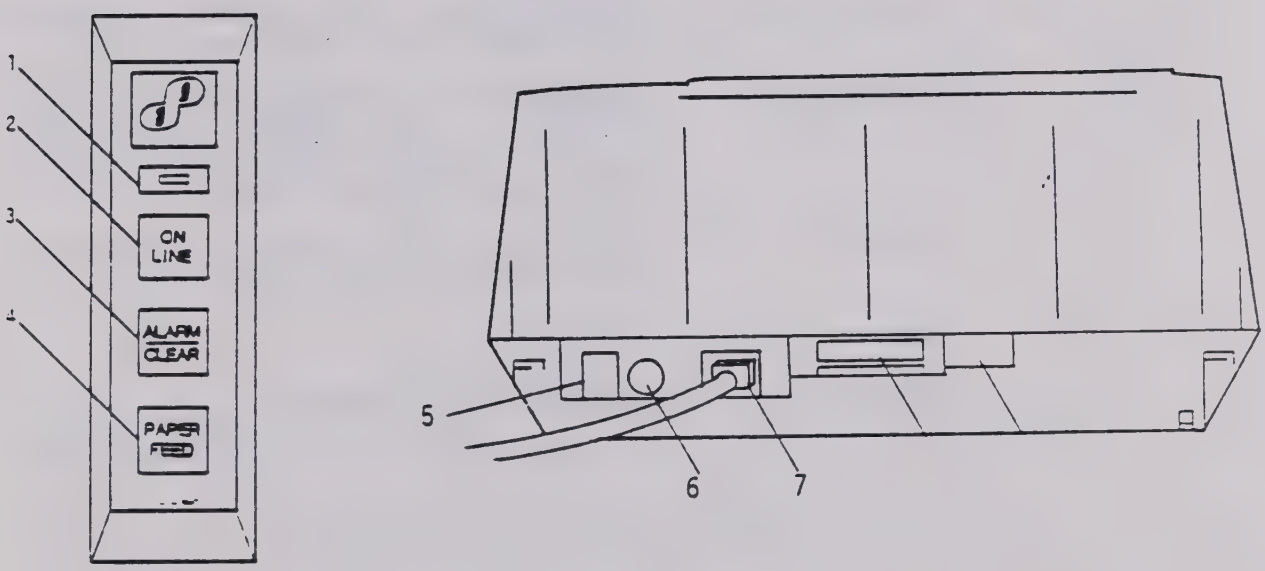



Figure 1-6. Optional Thermal Printer (DPC T-30)

Table 1-5. Thermal Printer (DPC T-80)

| Index No. | Item | Function |
|---|---|---|
| 1 | Power Indicator | Lights when power is applied to printer. |
| 2 | ON LINE | Switch function not used. Lighted remotely as long as the LSI-11 and printer are powered up and the interconnecting cable is properly connected. If ON LINE goes out, the printer has become disconnected from the system. |
| 3 | ALARM/CLEAR | Switch/Indicator. When pressed, will locally stop printing. ALARM function is not used. |
| 4 | PAPER FEED | Advances paper while it is pressed. NOTE: This function is passed through the interface. It will not operate locally until the system BOOT switch has been pressed. |
| 5 | ON/OFF | Applies ac power. Normally left ON for switched ac power from the system unit. |
| 6 | Fuse | AC line fuse. |
| 7 | Connector | Receptacle for ac line cord. |

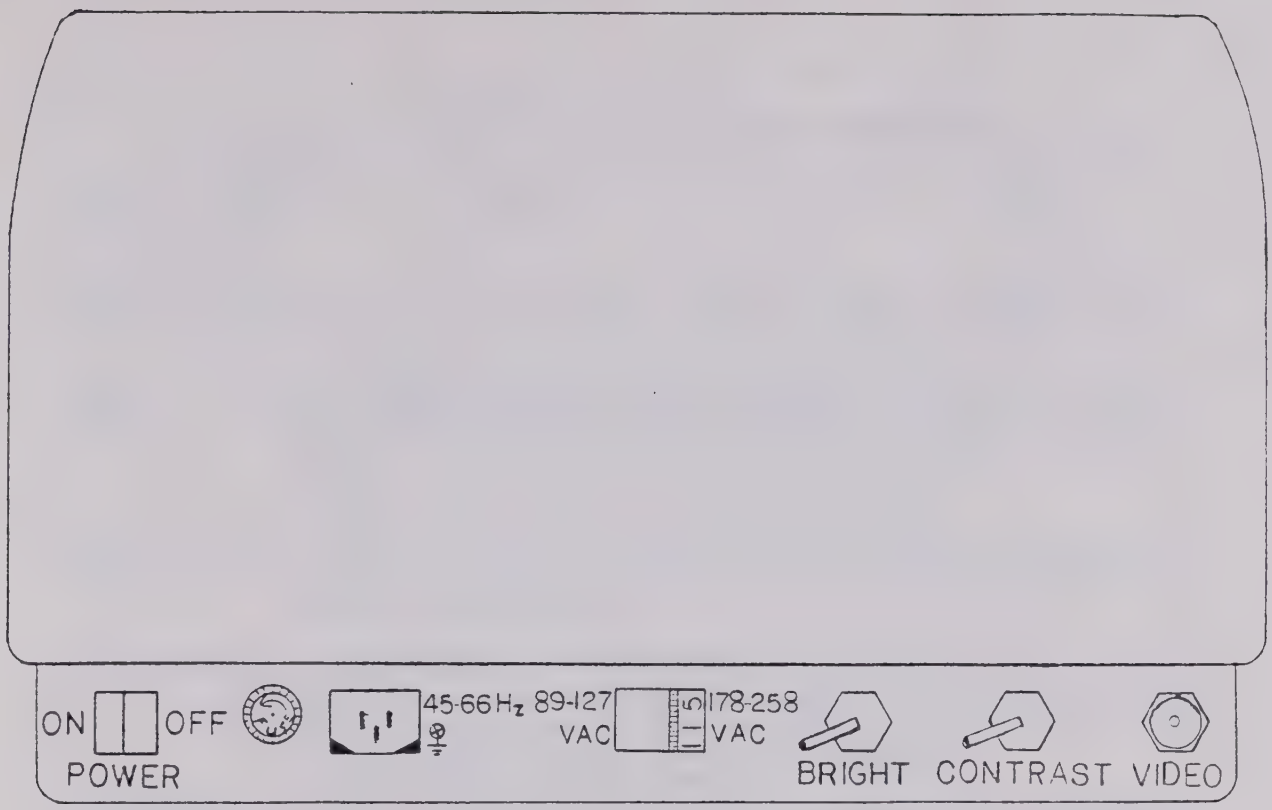



Figure 1-7. Display Monitor

Table 1-6. Display Monitor

| Index No. | Function |
|---|---|
| VIDEO | BNC video input from CRT connector on the system unit. |
| CONTRAST<br>BRIGHT | Picture controls. Adjust to suit. |
| 89-127 VAC 178-250 VAC | AC line voltage selector. |
| FUSE | AC line fuse. |
| POWER ON/OFF | AC line switch. Normally left on for switched ac from the 2511 unit power controller. |

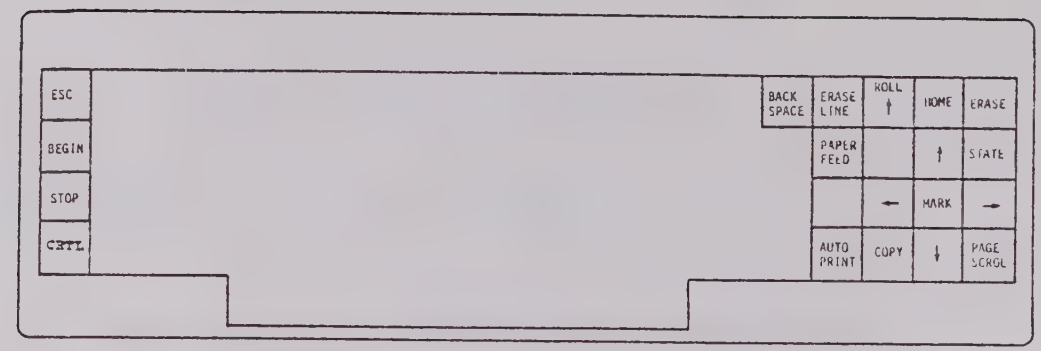



Figure 1-8. Keyboard - Special Function Keys

Table 1-7. Keyboard - Special Function Keys

| Item | Function |
|---|---|
| | NOTE<br><br>All inputs from the keyboard are intercepted and interpreted by the 2501 microprocessor before they are passed to the running program or display controller. The following list provides a generalized summary of the special key functions. For a more detailed description of the keyboard display functions are provided in Section IV. Also note that several of the keys perform multiple functions depending on which software program is running. For a description of how these keys function in regard to specific software program, refer to the appropriate Operating Manual. |
| ESC | Escape. It will generally be used to starts an escape sequence, indicating that next following key is to be interpreted as special command character. Escape sequences are not normally used in 2511/2514 software. |

Table 1-7. Keyboard - Special Function Keys (Continued)

| Item | Function |
|---|---|
| CTRL | Control. When held while another key is pressed, modifies the key code to become a non-printing ASCII control character. |
| BEGIN<br>STOP | These two keys are used with systems from other GenRad divisions which share the same keyboard. They currently have no function for the 2511/2514 and will be described in software manuals if used. |
| BACKSPACE | In normal operation, this key moves the cursor back one space, erases that character, and instructs the receiving program to delete it or ignore it. |
| PAPER FEED | If alpha AUTOPRINT and SCROL are both on , this key will cause the terminal to scroll the autoprint cursor down and thus feed the thermal printer paper, 66 lines from the last ERASE or HOME, thus approximating a form feed for an 11-inch page. |
| AUTOPRINT | Toggles auto-print mode on and off. Auto-print mode is used to keep a running copy of information on the screen. Its function differs according to whether the display is pure alpha or graphic. If the display is pure alpha, a tilda symbol appears as a cursor at the right end of the next line to be printed. The printer makes a copy of any data already on the display and thereafter continues line by line, printing whenever a carriage RETURN is entered or encountered in an output. AUTOPRINT is normally used in SCROL mode, but can be used with PAGE provided that the operator uses the ROLL function rather than HOME or ERASE to advance from a full page. HOME and ERASE cancel AUTO PRINT and will cause loss of the last line on a page, which is not printed until a roll or scroll command causes display of a new line. If there is any graphics information in the display, the auto-print cursor is a crosshair (plus sign) and the function and mode are changed to keep a dot by dot copy of information only as it is ROLLed or scrolled off the top of the screen. This mode is principally for program controlled production of "waterfall" or three dimension plots, but may sometimes be useful in terminal operation. These functions are discussed in Section III. |
| ROLL | A "manual scroll" that rolls the display up by 6 alphanumeric lines. This is done by actually repositioning data in the display memory of the 2501 microprocessor. ROLL is always active regardless of the display mode, what is being presented, or who is in control of display. |

Table 1-7. Keyboard - Special Function Keys (Cont.)

| Item | Function |
|---|---|
| ↑ (up arrow)<br>↓ (down)<br>← (left)<br>→ (right) | These keys move the display cursors. Their functions are as follows: Alpha Mode: The arrow keys move the alpha underscore cursor one line up or down, or one character left or right. Note that the left shift is not the same as the erasing BACKSPACE function. Graphic Mode: If an operating program has set up a graphic input situation, a full-screen cross-hair cursor will appear on the display for the operator. It can be moved one dot position at a time by tapping the arrow keys, four dots at a time by tapping faster than 3 times per second, or 16 dots (very rapidly) by holding the keys down for the auto-repeat feature of the keyboard. The up-down arrows are also used for special purposes by menu-driven programs such as ISAP, RANDOM, etc.. |
| COPY | When pressed alone, causes a dot-by-dot image of the full display to be reproduced on the printer. The copy size and proportions can be changed with the combinations of SHIFT/COPY and CTRL/COPY. These functions are discussed in Section III. COPY is normally used only in PAGE mode. |
| HOME | Erases the screen (i.e., the display memory) and forces the terminal into alpha mode with the alpha cursor (an underscore) in its home position at upper left corner. If a program happened to be drawing vectors in graphic mode, this would cause the display to begin printing nonsensical characters. This can be avoided with the ERASE key. Terminal modes are discussed in Section III. |
| MARK | This special key may be interpreted for various purposes by programs. It will generally be used as a signal from the operator that a graphics cursor or a menu selection pointer has been positioned as desired. |
| ERASE | Erases the screen without changing terminal mode. This allows a running program to continue in graphics. If it was in alpha, the underscore cursor returns home. If in graphics, the graphics cursor is not affected. |
| STATE | Similar to ESC operation. This key instructs the microprocessor that the following character is a command to toggle the condition of certain selectable keyboard states. These states are:<br>(STATE) L Local/remote toggle<br>(STATE) C Caps lock toggle |

Table 1-7. Keyboard - Special Function Keys (Cont.)

| Item | Function |
|---|---|
| | The terminal powers up in remote, with caps lock. These conditions are not changed for normal system operation. State control is discussed in Chapter 3. Note that STATE key is operated like ESC, not CTRL. It is not to be held down while the following command key is struck. States are described in Chapter 3. |
| PAGE/ SCROL | Toggles display mode between PAGE mode, requiring manual HOME, ERASE, or ROLL to continue from full page condition, and SCROL mode, with automatic six line roll up as page becomes full. The terminal can be forced to PAGE mode by striking SHIFT and PAGE/SCROL at the same time. |

# CHAPTER 2

# INSTALLATION AND CHECKOUT

This section is designed to cover field installation activities, from the arrival of the equipment at the customer's facility to its acceptance by the customer.

This procedure assumes that the equipment is at the installation site in its original shipping container(s). Note: All physical movement of boxes, system cabinet, and peripherals (including deskidding of cabinets) pertaining to the system, is to be done with customer supplied labor under GenRad supervision.

## 2.1 INSTALLATION POLICY

Initial installation and checkout at the customer facility is included in purchase and warranty conditions. Upon notification of receipt, GenRad Service personnel will come to the site, unpack and inspect the equipment, install and connect all units, and thoroughly check calibration and operation with diagnostic test programs and demonstrations of the operating software.

**WARNING**

These installation notes are for qualified service personnel only. Removal of covers may expose lethal shock hazards, particularily if ac power distribution has been damged or disturbed. Also, operation of the system before initial installation by GenRad personnel could aggravate possible damage to the equipment and may void the warranty.

If there is any evident damage to the shipping containers, the carrier's agent should be notified and requested to be present for unpacking.

## 2.2 SITE REQUIREMENTS

### 2.2.1 Location — Size and Weight

The system is intended for mounting on a sturdy bench, table or desk. Total weight of all units is apprroximately 130 pounds (58.5 Kg). Overall dimensions and weight of the major units are listed in Table 1-1.

### 2.2.2 Environment

While the equipment does not require special requirements, reasonable cleanliness and freedom from excessive dust are always necessary, particularly for the drive. Ideally, it should be located in a typical computer room environment with cool, filtered air, and positive air pressure to prevent dust infiltration. Requirements for the system as a whole are listed in Table 1-1.

### 2.2.3 AC Power

The 2511/2514 must be ordered for 115 or 230 VAC nominal, 50 Hz or 60 Hz. Field conversion of voltage or frequency is not practical. All units together, including the optional printer, draw 850 watts. The main power cord has either a 3-conductor grounding plug for 115 V service 15 A (4203-0012) or a 3-conductor grounding plug for 250 V service 6 A (4200-0280).

**WARNING**

The 3-conductor grounding power cord of the 2511/2514 must be connected only to a properly grounded service receptacle.

External grounding, other than through the main power cord and power cords to other units, is not required for this equipment. However, if desired, an external chassis ground is available and labeled on the rear of the panel.

For European installation, the American/Canadian standard 250 V plug must be replaced locally. The color code conversion is:

| Conductor | N. American | European |
|---|---|---|
| Neutral | White | Light Blue |
| Live (phase) | Black | Brown |
| Earth Green | Yellow/Green | |

## 2.3 UNIT INTERCONNECTS

### 2.3.1 AC Distribution

All units should be plugged into the SWITCHED AC receptacles at the rear of the main system mounting box. All local unit circuit breakers and power switches are normally left ON, so the entire system is controlled by the front panel ON/OFF rocker switch on the system box.

### 2.3.2 Signal Interconnections

The disk drive, keyboard, and printer have captive signal cables, all of which are connected to the plainly marked and keyed receptacles at the rear of the System unit box.

The display unit is driven by a video signal supplied through a separate BNC-to-BNC 50-ohm shielded coax cable. This cable is connected from "CRT" at the rear of the main unit to "VIDEO" at the rear of the display unit.

# CHAPTER 3

# OPERATION

Operation of the 2511 and 2514 systems under the various application software packages is described in separate software manuals. Basic operation consists merely of inserting the diskette and turning on power to boot the operating system and start the program as noted in the Condensed Operating Instructions of Chapter 1.

This section describes functions and operation of the hardware units—disk drive(s), keyboard-display unit, and optional printer— that are common to all the application packages. Also included are a more detailed description of the bootstrap-startup sequence, and an introduction to use of the RT-11 operating system in the form of a detailed procedure for preparing new disks and copying the original distribution disks. Further operations of RT-11 for file management after the system has been in use are given in Chapter 4.

## 3.1 GENERAL OPERATING NOTES

The following notes apply in general to system operation and should be kept in mind at all times.

NOTES

- If the diskettes have been stored in a different environment, they should be allowed to stabilize in their operating environment before use for 10 or 15 minutes.
- Floppy diskettes are not sealed devices. They should always be kept in their envelopes when not in use and preferably in closed boxes to prevent dust infiltration. Floppies may be stacked horizontally (not over 10) or stored vertically provided they are braced so they will not bend or sag.
- Never touch the recording surface of a floppy nor attempt to clean it in any manner.
- Do not expose diskettes to high heat or direct sunlight. Maximum storage temperature is 50 deg C (125 deg F).
- When writing labels on diskettes, use a soft tip pen. Do not use ball point pens, instruments that flake such as soft pencils, or grease pencils. Do not use paper clips to attach notes or labels.
- Never expose diskettes to strong magnetic fields or magnetized tools.
- Do not open the door of a floppy drive when it is actively engaged in an operation. Errors will result.

## 3.2 POWER UP/POWER DOWN

If all units are connected to the switched ac from the system unit power controller and their individual power switches and breakers are on as usual, then powering up the system is simply a matter of setting the front panel power switch to ON.

## 3.3 FLOPPY DISK OPERATION

There are no operator controls for the floppy disk drive(s) other than the latch(s) for the door(s). Operation consists simply of inserting disk(s) and closing the latching door(s). Disks are inserted with the head access slot leading in and the label side up. The seams of the jacket are on the bottom side (down).

The drives in the enclosure are oriented so that the drive on top is number Ø and the drive on the bottom is number 1. For the RT-11 operating system and GenRad application software, their device codes are DY0: and DY1:. Note the colon is a part of the device code even when it is not followed by a file name expression. This is further described in the operating procedures.

## 3.4 THERMAL PRINTER OPERATION

Printer copying operations are controlled from the keyboard and are described in the next paragraph on Keyboard-Display Terminal operation. The only operator function at the printer is loading of paper. The instructions are shown inside the printer lid. Observe the following notes for printer operation:

- Printing or plotting may be temporarily stopped by holding the ALARM/CLEAR button on the printer. The alarm clear function is not used otherwise in the system.

- The unit does not monitor the paper supply. It is up to the operator to make sure that the printer does not run out of paper. A red stripe will appear when the paper is within a few feet of the end of the roll.

- As the print head wears, copies will have less contrast. This can be compensated with the intensity thumbwheel under the lid.

- Print heads must be replaced periodically when the desired print contrast can no longer be obtained. The head is ejected by pulling forward on the latch on the head carriage. This is also illustrated inside the lid. New heads are simply pushed down into the same location until the latch closes.

## 3.5 KEYBOARD-DISPLAY TERMINAL AND COPY OPERATION

The keyboard and the video display unit, together with their interface and controller in the 2501 microprocessor, represent a "terminal" for the LSI-11 computer. The terminal provides the operator interface for communication with running programs, and in general its operation is controlled by the program. However, there are a number of independent terminal modes and functions that are controlled locally and are essentially the same regardless of what program is in control. The following paragraphs describe these functions and associated operations of the optional hard-copy printer. The printer is not an independent output device. Its function is only to provide copies of what appears on the display. However, it can do so in a variety of modes that are affected both by program control and by some terminal conditions as described below.

### 3.5.1 Terminal States

There are two terminal states that can be affected by the operator using the STATE key on the keyboard. Pressing STATE signifies that the next key, if it is one of the ones listed below, is a special command. The next key toggles the corresponding state on or off (or is ignored if not recognized), and cancels the effect of STATE for any further keystrokes. The selectable states are:

| | | |
|---|---|---|
| (STATE) | L | Local/remote toggle |
| (STATE) | C | Caps/lower case lock |

The system powers up initially in Remote on, Caps lock on. This configuration is the appropriate operating mode for all standard system software. It is neither necessary nor desirable to change any of these states for operation with GenRad application programs but they may be useful in special circumstances.

**3.5.1.1 Local/Remote State.** In the normal Remote state, all keyboard inputs are translated in the 2501 interface and passed on to the operating program in the LSI-11. These inputs are interpreted and then echoed back to the display if appropriate. In Local state, the terminal functions in the 2501 microprocessor are isolated from the rest of the system. This is basically the same function as the LOCAL/LINE switch commonly found on various other terminals. The Local state is not used in normal operation. However, it may occasionally prove useful to demonstrate some terminal functions, to insert off-line notes in printouts of transactions during operating sessions, or to type text to be copied on the printer.

**3.5.1.2 Caps Lock/Lower Case States.** In the normal Caps state, the keyboard sends the ASCII codes for the capital form of all letters, regardless of whether or not the SHIFT key is pressed. However, the keyboard is capable of transmitting lower case letter codes, and will do so if the state is toggled by STATE C. All GenRad system software operates on capitals and most of the programs will not recognize lower case. Thus, this state function should not normally be changed, but it may be useful when operating in Local as noted above.

### 3.5.2 Display Modes

At any given time, the terminal display is operating in one of three modes: alpha mode, graphics mode, or graphics input (GIN) mode. These modes are set by the operating program and the user has no direct control over them (except that terminal functions and modes can be programmed with the optional TSL software package). However, it is helpful to understand these modes as they have some effect on other keyboard controlled functions such as copying. These functions, in turn, are affected by certain commands and, therefore, will be referred to occasionally hereafter.

The operating program communicates with the terminal by transmitting 8-bit data bytes. When the terminal is in alpha mode, those bytes are interpreted as characters in ASCII code, either alphanumeric and symbol printing characters, or non-printing control characters. The codes are accordingly used by the character generator to write the corresponding character patterns in display memory and on the display screen.

When a program has set the display to graphics mode, the incoming codes are interpreted numerically as x and y coordinate values and are applied to the display vector generator. The generator writes vectors into display memory and thus draws lines on the screen for data displays and plots.

The third mode, GIN, is an interactive mode that allows the operator to manually designate a particular point on the screen. When the terminal has been placed in GIN mode, a set of full width crosshair cursors appears on the screen. The operator can then position the cursors using the arrow keys on the special keypad. When the operator is satisfied, he can send the x-y coordinates to the operating program by striking another key, usually MARK. However, application programs can specify other keys to be used. GIN mode can also be cancelled without sending the coordinates by striking the ERASE key.

### 3.5.3 Paging and Scrolling

The terminal mode may be switched from scroll mode to page mode or back again by striking the PAGE/SCROL key. If the current mode is not evident, page mode can be forced by holding SHIFT, PAGE.

In scroll mode, the display will automatically roll up by six lines whenever another carriage return-line feed would cause the next line to go off the bottom of the screen. This is generally the most convenient mode for entering command strings, conducting dialogs, or writing programs; that is, those operations where the keyboard is essentially in control. The AUTOPRINT copy mode can be used in conjunction with scrolling to keep a running record. However, the screen will scroll whenever that last (CR) occurs, regardless of whether (CR) is input from the keyboard operator or output from the running program. Thus if the program is outputting a long block of text, such as a directory or program listing, the automatic scroll will move the printout too fast for reading. AUTOPRINT, however, will hold each scroll long enough to make a copy.

In page mode, the operator has control over updating the display. When the screen is full, the terminal goes into a "busy" condition and refuses to accept new inputs from the keyboard or from program output. This condition is indicated by a bright square in the upper right corner. The display will remain in place until the operator specifically clears the full page condition by one of the following keys:

HOME will erase the display and return the alphanumeric cursor to its home position at upper left. From this position, the operator or the program output may continue. HOME also forces the terminal into alpha mode. HOME, therefore, should not be used if the current program is generating graphics displays. This is because continuing vector coordinate inputs from the program would then be interpreted as alpha characters which would give a nonsensical printout.

ERASE performs the same function as HOME if the terminal is already in alpha mode. If, however, it has been placed in graphics mode by an operating program, ERASE will clear the display. ERASE does not affect graphics mode or move the graphics cursor. This will allow a program to continue drawing plots.

ROLL is a manual scroll feature. It rolls the display up by six alphanumeric lines. This allows six more lines of display in page mode. ROLL is a convenient function for stepping through long printouts or entering programs without losing sight of the immediately preceding data. The roll function is always active and can be used regardless of whether the terminal is in page or scroll, alpha or graphics.

NOTE

When using AUTOPRINT in conjunction with PAGE Mode, always use ROLL to advance the display. HOME or ERASE will cancel AUTOPRINT and also lose the last line on the screen. This line is not copied until it is scrolled up.

### 3.5.4 Hard Copy Operations

Printer operation is controlled from the keyboard via the COPY and AUTOPRINT functions. Although similar in many respects, these functions represent two distinct modes of operation.

The COPY function in its basic mode produces a dot-by-dot duplicate of the entire video display. COPY will normally be used for printing plots and other graphics displays. COPY is also used for alphanumerics such as PAGE mode listings and printouts. However, the AUTOPRINT function is generally better suited for printing pure alpha displays.

COPY mode plots are available in three choices of size and aspect ratio, selected by the CTRL or SHIFT keys as follows:

COPY (alone): In this mode, a copy of the entire screen area is approximately 5.7 inches wide by 3.3 inches high. This is somewhat elongated compared to the screen proportions, but generally produces the most pleasing combination of alpha and graphics.

CTRL/COPY: In this mode, the copy area is the same 3.3 inches high but is compressed to about 4.25 inches wide. This closely approximates the proportions of the display screen. It is also the fastest of the three since it requires the least travel of the print head.

SHIFT/COPY: This mode also produces a copy in the same proportions as the screen. However, it is about 70 percent bigger than the CTRL/COPY version at 6.9 inches high and 7.25 inches wide. To achieve this size, the copy is rotated 90 degrees on the printer paper. This is done so that the printer's fixed 70 dots/inch vertical spacing can be used for the horizontal axis of the plot.

For pure alphanumeric data, the AUTOPRINT function is usually preferable. If there is no graphic, vector-type information in the current display, AUTOPRINT is an alpha-line oriented function. Striking the AUTOPRINT key toggles autoprint mode on or off. When it is turned on, a box symbol cursor appears at the right end of the next line to be copied. It then copies one line at a time, executing upon receipt of line feed characters from the running program or the keyboard operator. Line feed is automatically generated along with carriage RETURN or can be sent by striking the down-arrow key. If text is already present on the screen when autoprint is turned on, it will start at the top and copy through the last line that includes a line feed. Note that if the terminal is in PAGE mode, this will not include the bottom line of the screen. This is because a (CR) that would go off the bottom will not be accepted. AUTOPRINT may be used with PAGE mode but only if the ROLL function is used to continue beyond a full page. HOME or ERASE will cancel autoprint and lose that bottom line that is not printed until it is rolled up.

Alpha characters are formed in memory and on the screen in a 5-wide by 7-high dot matrix, with a character area 7 dots wide by 9 high. There are 7 dot printers in the printer head in a vertical distance of 1/10 inch for a print pattern of 70 dot spaces per inch vertically. In the imaging mode of the COPY function, this results in text printing of approximately 8 lines per inch. In AUTOPRINT mode, however, extra dot rows are inserted between lines to give text spacing of 6 lines per inch.

AUTOPRINT also has a graphics operating mode. AUTOPRINT will enter this mode if there are any graphics vectors in the current display when autoprint is turned on. Graphics autoprint is indicated by the appearance of a crosshair cursor (a plus sign) in the right margin rather than the box symbol for alpha mode. Graphics autoprint operates in the same dot-by-dot duplication mode as COPY, except that it prints the displayed information only as it is scrolled off the top of the screen. This function is generally program controlled and may be used to operate the printer in a chart recorder or waterfall display mode. However, this function can be activated from the keyboard by selecting AUTOPRINT while a graphics display is present and then using the ROLL function to scroll the display off the screen to the printer.

## 3.6 ORGANIZATION OF DISTRIBUTED SOFTWARE

The software distributed with the System consists of two major categories. These categories are:

- An abbreviated version of the DEC single-user operating system called RUN-TIME RT-11, which is normally supplied on a disk by itself.
- One or more GenRad application program packages such as RANDOM, ISAP, TSL, etc. The application diskettes normally contain the RT-11 system software as well.

RUN-TIME RT-11 provides the basic programs necessary to operate the system, to load and run the application programs, and to perform file management operations on the various peripherals.

The GenRad application packages usually consist of one main program file (a .SAV type, which means it is an executable program, ready to run under RT-11). These packages may also include miscellaneous supporting files which may contain utility subroutines and/or test data files. The specific content of each package is listed and described in its separate software operating manual.

As a matter of course, all original distribution disks should be immediately duplicated to create working copies. The original should then be stored - both for security in case the working copy is damaged and for historical purposes if the working copy is modified. The rest of this section provides an introduction to RT-11 operations specifically based on procedures to start and run the RT-11 monitor, prepare new disks, and copy the original distribution disks.

## 3.7 INTRODUCTION TO RT-11

Before attempting the procedure for duplicating disks, there are certain conventions, rules, and forms that should be known to understand the commands and functions that are used. The following paragraphs briefly describe the RT-11 package and the general information you will need. These subjects are described in more detail in Chapter 4.

### 3.7.1 RT-11 Disk Contents

The run-time RT-11 operating system supplied with the system consists of the program files listed below. These files will show up in device directory listings produced in the procedures that follow.

**Bootstrap Loader:**

This program loads the RT-11 monitor and performs certain system initializing functions. The bootstrap does not appear in a volume directory, but must be present on any RT-11 system volume.

**RT-11 Monitor:**

| | |
|---|---|
| RT11SJ.SYS | Monitor program. |
| SWAP.SYS | Reserved area on disk used by monitor when swapping certain utility routines in and out of memory. |

**DEC Device Handlers:**

| | |
|---|---|
| TT.SYS | Terminal |
| DY.SYS | Double-density floppy disk |
| DL.SYS | Hard disk (not available on some systems). |

**DEC File and Device Utilities:**

| | |
|---|---|
| PIP.SAV | Peripheral Interchange Program (COPY). |
| DUP.SAV | Device Utility Program (INIT, BOOT, etc.). |
| DIR.SAV | Directory Reader (DIRECTORY). |
| RESORC.SAV | System Resource Lister (SHOW). |
| FORMAT.SAV | Hardware formatter (FORMAT). |

NOTE

The standard RT-11 format utility (FORMAT.SAV) cannot be used with GenRad systems. You must use the GenRad utility FORMGR.SAV to format your diskette. If you use FORMAT.SAV, the following message is printed.

To format a disk, use the program FORMGR.SAV as follows:

```
.RUN FORMGR
*DY
DY:1 FORMAT - are you sure? ___
```

| | |
|---|---|
| SIPP.SAV | Save Image Patch Program for making corrections and changes in binary program files. |

**GenRad Utilities:**

| | |
|---|---|
| STARTS.COM | Indirect command file always called by the monitor to automatically execute certain startup functions. |
| SYSINT.SAV | Date/Time request, called by STARTS. COM and analog input hardware initializer. |
| ERASE.SAV | Clears the screen, called by STARTS.COM. |
| FORMGR.SAV | Diskette Hardware Formatter. |

Individual GenRad application program diskettes usually include all of the above, with rare exceptions where there is not room for all of them plus the application program. In most cases, it is desirable that all of these programs be available when operating. The absolute minimum RT-11 system for running application programs must include:

| | |
|---|---|
| Bootstrap | |
| RT11SJ.SYS | Monitor. |
| SWAP.SYS | Monitor swap file. |
| DY.SYS | Handler for floppy disk. |
| TT.SYS | Terminal handler. |

### 3.7.2 Device Names

Each peripheral device known to RT-11 has a permanent device code. The only ones applicable for the 2511/2514 are listed below. These codes may always be used to refer to a specific hardware device and unit. Note, however, that devices can also be given a logical name via the monitor's ASSIGN function. This function is described in Chapter 4. Two logical names that are always assigned are also listed below. The colons (:), as shown, are a part of the codes and must be included even if the device name is not followed by a file designation. Each code consists of a two-letter mnemonic for the device and one digit for the unit number. If the number is not given, unit 0 is assumed.

TT: The Terminal.

DYn: Double-density floppy disk drive(s).

SY: The System device, meaning the device from which the monitor is running. SYn: may be used to refer to other units of the same device, where n is a unit number.

DLn: Winchester disk drive divided into two logical units DL0 and DL1.

DKn: The default device and unit which will be assumed by the programs if no specific device is indicated in reference to a file. DK is initially the same as the SY device from which the monitor is run. If desired, the default may subsequently be assigned elsewhere. For example, if the system is booted from DY0: but it is desired to place all data files on DY1: without having to include the device code every time, the default can be assigned with the following command:

```
.ASSIGN
Physical device name? DY1:
Logical device name? DK:
```

Thereafter, any file reference that does not include a device code will be written on or searched for on DY1:. Device code SY: will still refer to DY0:, since that is where the monitor came from.

### 3.7.3 File Names

All programs and data on storage devices are organized into files. These files are identified by a file name and a file type extension separated from the name by a period. The name may be one to six alphanumeric characters. The extension may be one to three alphanumeric characters (no spaces, tabs, or symbols allowed). Two files with the same name and extension cannot reside on the same device. However, they can be on different devices. Thus a complete file reference has three parts:

dev:filnam.typ

File names for the software supplied are preassigned. These names will be shown in device directories in the following procedures. In operating application programs, the operator may assign his own file names. In fact, he can rename the basic program files if desired. However, there are certain conventions and default conditions that must be observed. For example, the following file types have special meanings to the system and application software:

.BAD A special type used to cover bad blocks on storage devices. Once created, these files cannot be moved or deleted without special action.

.COM An indirect command file. The supplied software will have files calleds STARTS.COM. These files are automatically read by the monitors when they are booted.

.DAT A data file.

.SAV A memory image file of a program ready to RUN under the monitor.

.SYS A system file, i.e., the monitors and device handlers. These files also cannot be moved, copied, or deleted without special commands which are noted in Section IV.

### 3.7.4 Certain Prompts and Control Characters

The following characters and commands may appear or be necessary at various places in these procedures:

| | |
|---|---|
| . (dot) | This is a prompt from the keyboard monitor. It is printed when the monitor is in control and ready to accept a command. |
| RETURN key | The carriage RETURN is the terminator and execution command required for all keyboard entries. It will be indicated by the symbol (CR) in the first few procedural steps that follow, but thereafter is assumed. There are a few special commands within the applications programs that do not require (CR). |
| CTRL/C | Abort. Stop the running program and return to monitor. CTRL/C must be entered twice if the program is not at a point where it is expecting input. |

### 3.7.5 Correcting Typing Errors

If a typing error is noticed before entry of a command is terminated by (CR), it can be corrected as follows:

| | |
|---|---|
| BACK SPACE | Erases one character at a time. Deletes or ignores those characters in the program's command input buffer. |
| CTRL/U | For typing errors, this command deletes the current input line and allows you to start over on a new line. This function is also performed by the ERASE LINE key if it is present on the keyboard. |

### 3.7.6 Monitor Command Forms

When communicating with the monitor, the operator may enter commands two ways. Commands may be entered in a long, multi-line form where the monitor will prompt for the needed information. Commands may also be entered in a single-line short form. The following examples illustrate these forms where a command is used to copy a file from one device to another. The bold faced parts are the operator entries with (CR)s indicated. Long form, with prompts:

```
.COPY(CR)
From? DY0:MYFILE. EWP(CR)
To? DY1:MYFILE.EWP(CR)
```

Short form, one line. One SPACE separates the command part and the other entries from one another:

```
.COPY DY0:MYFILE.EWP DY1:MYFILE.EWP(CR)
```

The result of these two forms is exactly the same. The operator may use either. This depends on whether the operator wishes to be prompted or to remember what is required. Both types are used in the following procedures. If an option selection is attached to the command or to a file spec, that option must be included in the same line. Options specify particular actions when the basic command has more than one function. The general forms are:

```
.COMMAND(/option)
PROMPT1? input-file(/option)
PROMPT2? output-file(/option)
```

or .COMMAND(/option) input-file(/option) output-file(/option)

where the square brackets indicate optional parts that may or may not be included, input-file represents the source or file to be operated on, and output-file represents the destination or result. If the command operates on only one file it is considered to be an input.

Example:

```
DELETE DY1:MYFILE.EWP
```

Monitor commands, which are listed in Section IV, may be spelled out completely or abbreviated to as few letters as will make the command distinguishable from any other. In general, four letters will always be sufficient although fewer can be used in many cases. The one above, for example, could be:

```
DELE filnam.typ
```

D or DE cannot be used since they could be confused with DEASSIGN. If the monitor does not have enough letters, it will not attempt to execute the command and will return an error message as follows:

```
?KMON-F-Ambiguous command
```

### 3.7.7 Error Messages

The RT-11 system has an extensive set of error checks and messages such as the one shown above. These messages consist of three parts. The first part indicates which system program issued the message. KMON, above, means keyboard monitor. However, other messages may be seen from any of the other programs such as PIP, DUP, and DIR. The second part indicates whether the message is informational (I), warning (W), or fatal (F). Informational or warning messages are usually associated with other system programs such as assemblers or compilers that are not included in run-time RT-11. Most of the messages seen will be fatal. However, this is not as drastic as it sounds. Essentially, this means that the command cannot be executed either because there was something incorrect in form, or because required files or information were not available. Most errors will be typing errors. Usually, the third part will make the error obvious with an

explanatory message. A few typical errors that might occur in the following procedures are:

?BOOT-F-No boot on volume
The necessary bootstrap loader has not been copied to the volume.

?FORMAT-F-Device not ready
No disk mounted or device off-line.

?KMON-F-Command file not found
This error message will appear every time the monitor is booted if it does not find a STARTS.COM file. There will be a STARTS.COM file on most distributed software. After the system has been used, STARTS.COM file may not be present on all disks. The operator should ignore this message unless he specifically expected the file to be there.

?KMON-F-No file
No file spec was entered when the command expected to find one.

## 3.8 BASIC OPERATING PROCEDURES

With the general information in the previous paragraph, the operator is ready to operate the system. The basic procedures and application programs are essentially:

(1) Mount diskette with RT-11 system and applications.

(2) Turn power switch ON.

(3) Press the BOOT/HALT switch towards boot. The system will return the prompt DEV >. In response to the prompt, you can boot the drive DY0: by either entering DY(CR) or DY0(CR). To boot to drive DY1:, enter DY1(CR).

(4) Start the application program and refer to its corresponding manual for specific instructions. This is automatic with much of the software.

There are some additional procedures that must be performed when the system is initially operated and whenever attempting to use brand new disks. These procedures are:

(5) Formatting new diskettes for double density usage

(6) Initializing diskettes for RT-11

(7) Duplicating the original distribution software for security.

The following paragraphs provide step-by-step procedures for these functions. The only exceptions are power up and mounting disks which were described at the beginning of this section. Since this is also an introduction to RT-11 operation, some additional notes and exercises have been included. All operator entries are underscored or shown in bold face type.

### 3.8.1 Bootstrapping the Monitor

Step 1. Mount the diskette containing the RT-11 system programs on drive #0.

NOTE

For normal operation, this presumably will be the diskette with the desired application program (e.g., ISAP, RANDOM, TSL, etc.) also on it. However, for this initial copying procedure, the operator should begin with the floppy whose label indicates "RT-11 System" or some similar notation.

Step 2. Power up the system. Press the ERASE key to erase any leftover or random startup display. Press the BOOT/HALT switch up towards boot. The system will respond by printing the following prompt:

DEV> (Note that on some of the early systems the AED>prompt may be printed instead of the DEV>prompt.)

The two methods of booting drive DY0: are by typing DY(CR) or typing DY0(CR). To boot drive DY1:, type DY1(CR).

Step 3. The monitor will load, start and identify itself by printing:

RT-11 SJ (S) V05-XX

Step 4. Press the AUTOPRINT key, if desired. This is done to keep a running record of the following transactions and to get hard copies of disk directory listings. The box symbol cursor should appear at upper right. One or two lines may print as explained below.

Step 5. The terminal may power up in either PAGE or SCROLL mode. If one or the other is preferred, enter SHIFT/PAGE to force PAGE mode. Strike the PAGE/SCROL key to switch to SCROLL or alternately back to PAGE. If AUTO-PRINTing, use ROLL rather than HOME or ERASE to advance from full page.

Step 6. When the monitor is booted, it searches for a STARTS.COM file and executes its commands.

NOTE

All system volumes supplied by GenRad will have a STARTS.COM file as described below. However, after the system has been in use, new system volumes may not have one. In that case, the monitor will print the following error message and its prompting dot (.). The system is now ready for entry of monitor commands as described in paragraph 3.8.2 and Chapter 4.

?KMON-F-Command file not found

The STARTS.COM file supplied by GenRad performs certain initializing operations. It then runs the SYSINT.SAV program to initialize the ADS analog input and requests entry of date and time. The commands are usually printed as they are executed, e.g.:

```
.R ERASE
.SET TT SCOPE
RUN .SYSINT
2500 V1 System
2511 Q DAS Online
ADS - Initialize
      -12 Bits
      -2 Channels
Memory Size: 64K words
1-AUG-83  change date? _____
Please Enter Time: _____
```

Step 7. The date is required. Enter it in the form dd-mmm-yy, including hyphens.

Example:

1-DEC-80(CR)

NOTE

The date entry is required to satisfy the SYSINT routine. If for some reason you do not wish to date the system, you may enter CTRL/C to abort SYSINT and return to monitor. If the monitor started without a command file, you may enter a date with the DATE command of the monitor, e.g.:

.DATE dd-mmm-yy

This command can also be used to change the date at any time without rebooting for SYSINT (see Chapter 4).

To accept the current date, press the carriage RETURN key.

Step 8. SYSINT will next request entry of time:

PLEASE ENTER THE TIME:__

The time entry is optional. If not wanted, just strike (CR). If desired, enter time in the form hh:mm:ss, including colons.

Example:

13:20:00(CR)

NOTE

This SYSINT time entry is for the GenRad 2501 microprocessor clock. It is used by some of the application programs and printed in some plots. However, it cannot be read out by means of the TIME command from the monitor.

Step 9. If the "RT-11 System" disk is being used, control will also return to the monitor at this point. However, if an application program disk is being used, it will usually contain only one program. The STARTS.COM file will usually contain a command to start that program automatically. The application program will indicate that it has started in some manner such as presenting a plot or identifying itself with its own input prompter.

Step 10. If an application program has self-started, the operator is ready for normal operation as described in the appropriate application software manual. However, for these initial procedures it will be necessary to get back to the monitor to prepare duplicate disks and new blank disks. The following paragraph describes calling the application programs and returning to the monitor.

### 3.8.2 Stopping and Starting Application Programs

Step 1. To load and start an application program when the monitor with its prompting dot, is in control, enter a RUN command and the file name of the specific program. If, and only if, the program is on the system (i.e., the monitor) volume, which will usually be the case, the short form of the command is:

.R filnam(CR)

e.g.: .R RANDOM(CR)

NOTE

Refer to the program manuals and the directories that will be obtained in the following paragraph for the program file names.

If the program file is on a different device, the full command form must be used, e.g.:

.RUN dev:filnam (.SAV)

The .SAV extension is not required. The RUN command assumes a .SAV type unless some other type is specified. Executable programs normally are of the .SAV type.

Step 2. To stop a running RT-11 utility or other application program, enter the abort command character, CTRL/C; twice, if necessary. It will echo ^C and return the monitor prompt as follows:

```
(CTRL/C)(CTRL/C)
^C
^C
.
```

NOTE

When a utility or application program is performing an operation, CTRL/C may be a drastic way to stop. It may result in incomplete functions or loss of files that have not been closed. CTRL/C should be used only when the program is in an idle or standby condition unless it is really necessary to stop the operation in progress.

Step 3. To restart a program: If, while in monitor after halting a program, the operator has entered no commands that required loading of another program, he can restart the original program at its normal entry point with the monitor REENTER command, e.g.:

```
(CTRL/C)
.REEN  (program restarts)
```

This is a common practice with the optional TSL package. CTRL/C aborts will be used frequently in debugging, and the operator will want to use REENTER rather than a new RUN. This will preserve resident TSL subroutines. If any error conditions that prevent a restart have occurred, the REEN command will be refused as illegal.

### 3.8.3 Formatting Floppy Disks for Double Density

New floppy diskettes must be formatted before they can be used by RT-11. This is done through the GenRad format utility FORMGR.SAV as follows:

**CAUTION**

Formatting is a data-destructive process that irretrievably destroys any previous data on a disk. Always check that there is nothing wanted on the disk before reformatting. Although new disks are assumed here, this procedure will introduce the DIRECTORY function to check the content of a disk. Also note that reformatting a used disk can sometimes recover blocks that have gone bad during use. Note that formatting is only applicable to floppy drives.

Step 1. If this procedure is being performed for the first time, the RT-11 system volume disk will presumably be mounted and running as described in the preceding paragraphs. If not, mount a disk containing the RT-11 system on drive #0 and bootstrap the system. If an application program on the disk starts automatically, enter CTRL/C to stop it and return to the monitor.

Step 2. In response to the prompting dot of the monitor, enter a DIRECTORY command as shown below to obtain a directory listing of the system (default) volume. The command used includes several options to request that the directory include the volume identification (/VOL), the starting block number of each file (/BLOCK), any unused spaces (/FULL), and that it be printed in one column (/COL:1). These options are mainly for demonstration. For subsequent directories in this procedure, the DIR command may be used. This command will print the file names, sizes, and dates only, in a two-column format (reading across). Other directory options are described in Chapter 4.

```
.DIR/VOL/BLOCK/FULL/COL:1 <CR>
```

Step 3. The directory should appear much as the list of RT-11 files shown in paragraph 3.7.1 plus any application programs that may be included. In particular, check that files TT.SYS, DUP.SAV, PIP.SAV, and FORMGR.SAV are present. These files are required for the rest of this procedure.

Step 4. Mount a new, blank floppy in drive 1 (device code DY1:). A used disk that has nothing on it of value may also be used.

Step 5. Since formatting is data-destructive, it is always a good safety practice to make sure there is nothing wanted on the target disk. Although a new, blank disk was assumed, enter the following command to get a directory of the target:

```
.DIR DY1:(CR)
```

If the disk is new and uninitialized, the system should return the following error message:

```
?DIR-F-No directory on volume
```

If it is a used disk and a directory does appear, check that there is nothing wanted.

Step 6. Enter the FORMGR command and the name and unit number of the device where the disk to be formatted is located, as shown below. Note the confirming query from the system. When certain the correct device was entered, respond with a Yes as shown:

```
.FORMGR DY1:(CR)
DY1:/FORMAT-Are you sure? Y(CR)
```

Formatting takes some time. When it is done, the system returns the informational message:

```
?FORMAT-I-Formatting complete
```

Step 7. At this point, if desired, continue to format several new disks by mounting each one in turn on DY1: and repeating steps 5 and 6. Alternatively, go to paragraph 3.8.4 to INITIALIZE and copy to this first disk while it is still mounted. In the latter case, remember that the operator must come back to this step and format all subsequent disks before using them. Other FORMAT options are described in Chapter 4.

### 3.8.4 Initializing

All new disks must be initialized before they can be used with RT-11. Whereas formatting had to do with the hardware, initializing is a software process. On a new disk, initializing sets up an RT-11 directory in a fixed location. Data can then be stored, retrieved, and manipulated by RT-11 file names rather than by absolute hardware locations. On a previously used volume, initializing sets all existing files to a deleted status. This means that the entire volume is considered unused and available for new files. An initializing option, used here, can check the disk for bad blocks and cover them to prevent future use. Other options are described in Chapter 4. Proceed as follows:

NOTES

- Do not INITIALIZE any volume containing desired files. Although INITIALIZE does not actually erase any data, it changes the directory entries such that the volume appears to be unused. Subsequent recovery of files is possible until they have actually been overwritten by new ones. This recovery can be a difficult and tedious process and is not fully covered in this manual. If you are not sure what, if anything, is on the target disk, use .DIR DY1: to get a directory and check it. If the disk has not been initialized, the DIR command will return a directory error message.

- Occasional bad blocks may occur on new disks. The command option used in the following step instructs the INIT process to scan the disk for bad blocks. This is done by reading every block on the disk. If the INIT/BAD process finds any bad blocks, a commotion will be heard in the floppy drive as it attempts to read

a bad block several times before giving up on it. Should this occur immediately after the start, abort the operation with two CTRL/Cs. Early bad blocks are probably in the system or directory area. This makes the disk unusable. Later on in the disk, a few bad blocks may be tolerable. However, since at this point, basic working copies of the original software are being prepared, any disks with bad blocks should not be used. Abort the INIT/BAD operation whenever the drive tries and fails to read a block. As a general rule for subsequent operations, abort whenever this function seems to have found several bad blocks. When INIT/BAD does find bad blocks, it writes one-block files named FILE.BAD. This is done to cover the blocks so they will not be used in subsequent operations. FILE.BAD files will not be copied, moved, deleted, or otherwise manipulated without special commands. When INIT/BAD completes or is aborted, it prints a list of the block number addresses of any bad blocks. Bad blocks can frequently be corrected by reformatting or using the FORMGR/VERIFY function described in Chapter 4. Note that after a disk has been in use, a bad block scan can be performed without initializing the disk or writing FILE.BAD. This is done using the DIRECTORY/BADBLOCKS function.

Step 1. Enter the following command and a Yes response to the confirming query to establish and/or clear the volume directory and search for bad blocks:

```
.INITIALIZE/BADBLOCKS DY1:
DY1:/INIT-Are you sure? Y(CR)
```

Step 2. After a disk has been initialized, an empty directory exists and can be read:

```
.DIR DY1:

0 Files, 0 Blocks          (Number may vary slightly
974 Free Blocks            according to directory size.)
```

Step 3. At this point, repeat (1) and (2) to initialize a supply of formatted disks. Alternatively go to paragraph 3.8.5 to copy the running system disk to this new disk. Repeat the FORMAT and INITIALIZE steps for each additional disk to be copied.

### 3.8.5 Copying Distribution Disks

**3.8.5.1 Copying Distribution Diskettes on Two Drive Systems.** With target disks formatted and initialized as described in preceding paragraphs, you are now ready to copy the software from the original distribution disks to working copies. This process is performed in two (or three) stages to (1) copy all files from one disk to the other, (2) extract the bootstrap from the monitor and the system device handler and write it into reserved system locations on the new disk, and, if desired, (3) write a volume identification and owner's name on the new disk. Proceed as follows:

NOTE

For subsequent operation, you should be aware that there is an alternate method called COPY/DEVICE which can only be used by systems equipped with two disk drives. This method will combine all three of these steps. COPY/DEVICE copies everything from one device to another, one physical block at a time, producing an exact duplicate of the original, including bootstrap blocks, volume ID, directory, data blocks, and even unused spaces. COPY/DEVICE also destroys anything that existed on the target. With COPY/DEVICE it is not necessary to INIT the target. The directory is copied over rather than re-created as the operation proceeds. However, COPY/DEV is not appropriate for this inital procedure because it should not be used if: (a) the volumes have different numbers of physical blocks (e.g., single to double density) or (b) there are any bad blocks on either end as they would not be treated with any special consideration.

Step 1. The monitor is presumed to be running from the volume to be copied on device #0. If not, mount and bootstrap it.

Step 2. The target disk is presumed to be FORMATted and INITed. Mount the target on DY1:.

Step 3. Enter the following command:

```
.COPY/SYS
From?DY0:*.*
TO?DY1:*.*
```

This command will copy all files from the original to the target. The command will also print a log of their names as the operation is performed. The /SYS option indicates that system files type .SYS are to be included in the operation. If not specifically requested, they are normally excluded from COPY functions. The asterisks (*.*) are "wildcard" symbols which replace filnam.typ and mean all files of all types. They are not actually required as the COPY command assumes all files by default if only a dev: name is given.

Step 4. Enter the following command to extract the bootstrap from the monitor and system device handler (which must be present on a new system volume) and write it into its fixed location in blocks 0 and 2 through 5 of the target device.

```
.COPY/BOOT
From?DY1:RT11SJ.SYS
To?DY1:
```

Step 5. Optional. If desired, a volume identification and owner's name of up to 12 characters each can be written on the copies. The original distribution disks use these for software package name and part number. If you want to keep this same information on your copies, you may read it from the original with a DIR command option and write it to the copies with an INIT command option as shown below:

```
.DIR/VOL:ONLY DY0:

Volume ID: RT-11/TSL       (typical)
Owner    : 2510-0610-03    (typical)
```

NOTE

Be sure to include ":ONLY" in the following command. If you dont't the copies just created will be re-initialized. If this is accidentally done, copies can be "uninitialized" with the command INIT/RESTORE. However the boot must then be recopied as in (4) above.

```
.INIT/VOL:ONLY DY1:

Volume ID?          (up to 12 characters)
Owner?              (up to 12 characters)
```

Step 6. Optional. Distribution disks may be supplied with the files "protected". This is indicated by a P following the file size in directory listings and means they cannot be deleted. Protection is carried through the copy

operations. Protection may be removed from all files of copies with the following command:

```
.RENAME/NOPROTECT dev:*.*
```

Step 7. Test bootable copies with the following command:

```
.BOOT DY1:
```

This is a "software" boot. RT-11 should restart, identify itself, and the STARTS.COM/SYSINT programs will request date and time again.

Step 8. Remove the original disk from drive #0. Store it for security.

Step 9. Since all system application package disks normally have the RT-11 system on them, repeat this entire bootstrap, format, initialize, copy, copy/boot procedure for each one as summarized in the next paragraph.

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replace filnam.type and means all files of all types. They are not actually required as the COPY command assumes all files by default if only a dev name is given.

```
.COPY/SYS/WAIT
From ? DY0:*.*
TO ?  DY0:*.*
Mount input volume in DY0: Continue Y
    Files copied
Mount output volume in DY0: Continue Y
Mount input volume in DY0: Continue Y
Mount output volume in DY0: Continue Y
Mount input volume in DY0: Continue Y
DY0:TT.SYS  TO  DY0:TT.SYS
```

NOTE

The only answer that the query continue will accept is Yes. Any other response will be rejected and the query will be repeated.

This sequence is repeated for each file until all of the files have been copied to the target disk.

Step 3. Enter the following command to extract the bootstrap from the monitor and system device handler (which must be present on a new system volume) and write it into its fixed location in blocks 0 and 2 through 5 of the target device:

```
.COPY/BOOT/WAIT
From? DY0: RT11SJ.SYS
To? DY0:
```

Step 4. Optional. If desired, a volume identification and owners name of up to 12 characters each can be written onto the copies. The original distribution disks use this for software package name and part number. If you want to keep this same information in your copies, you may read it from the original with a DIR command option and wirte it to the copies with an INIT command option as shown below:

```
.DIR/VOL:ONLY DY0:
Volume ID:RT-11/TSL  (typical)
Owner: 2511-0610-04  (typical)
```

NOTE

Be sure to include ":ONLY" in the following command. If you do not, the copies just created will be re-initialized with the command INIT/RESTORE. However the boot must then be recopied as in (12) above.

Remove the system disk and mount the copy. Then enter the command as shown below:

```
.INIT/VOL:ONLY DY0:
DY0:Volume ID change; are you sure?
Volume ID? (up to 12 characters)
Owner? (up to 12 characters)
```

Step 5. Optional. Distribution disks may be supplied with files protected. This is indicated by a P following the file size in directory listings and means they cannot be deleted. Protection is carried through the copy operations. Protection may be removed from all files of copies with the following command:

```
.RENAME/NO PROTECT dev: *.*
```

Step 6. Test the software boot of the copy by entering the following command.

```
.BOOT DY
```

RT-11 should start, identify itself, and the STARTS.COM/ATDATI programs will request date and time again.

### 3.8.6 Summary of Initial Disk Duplication Procedure

The initial steps and commands for preparation of new disks and copying of originals are on a dual disk drive system as follows.

**Mount** system/application volume to be copied on DY0.

**Mount** new target disk on DY1.

**Press** BOOT/HALT switch.

DEV>**(CR)** (Boot monitor, STARTS.COM/SYSINT.)

Enter **date** and **time** if desired.

**CTRL/C** to monitor if application program self starts.

**.DIR DY1:** (If in doubt as to volume status.)

**.FORMGR DY1:** (hardware format new disk.)

**.INIT/BAD DY1:** (initialize directory)

**.COPY/SYS DY0: DY1:** (copy all files, including .SYS)

**.COPY/BOOT DY1:RT11SJ.SYS DY1:** (Make new volume bootable.)

**.INIT/VOLUMEID:ONLY DY1:** (Optional ID and name.)
ID? **12 characters**
Owner? **12 characters**

**.BOOT DY1:** (Test new volume.)

**.RENAME/NOPROTECT DY1:*.*** (Optional. Remove file protection.)

**Remove** original from DY0 and store.

**Repeat** for additional distribution disks,
or
**Mount** copy in DY0, boot, and RUN application programs.

The initial steps and commands for preparation of new disk and copying of orignals on single disk drive systems are as follows:

**Mount** system/application volume to be copied on DY0.

**Press** BOOT/HALT switch.

DEV>**(CR)** (Boot monitor, STARTS.COM/SYSINT.)

**Enter** date and time if desired.

**CTRL/C** to monitor if application program self starts.

**Remove** system volume and mount target disk.

.DIR DY0: If in doubt as to volume status

Remove target disk and mount system volume

**Enter .R FORMGR** (hardware format new disk)
Device:
***DY0:/W**
DY0:/Format are you sure? **Y**
**Remove** system disk and mount target disk. Continue? **Y**

**Remove** target disk and mount system disk
**Enter CTRL/C** to exit FORMGR and return to RT-11.

**.INIT/BAD/WAIT** (initialize directory)
Device: **DY0:**
DY0: Initialize; Are you sure? **Y**
**Remove** system disk and mount target disk. Continue? **Y**

**Remove** target disk and mount system disk

**.COPY/SYS/WAIT** (Copies all files one at a time, including.SYS)

**.COPY/BOOT/WAIT** (Make new volume bootable)
From.? **DY0: RT11SJ.SYS**
To? **DY0:**
**Remove** system disk and mount target disk. Continue? **Y**

**.INIT/VOLUMEID:ONLY DY0:** Optional ID and name
ID? **12 characters**
Owner? **12 characters**

**.BOOT DY0:** (test new volume)

**.RENAME/NO PROTECT DY0:** Optional. Remove file protection
**Repeat** for additional distribution disks, or
**Run** application program.

NOTE

To copy disks or files between older GenRad systems which utilized a dual 8 inch floppy disk drive and the 2511/2514 which utilizes a 5¼ inch floppy disk drive requires the use of the optional DataLink™ software package, part number 2501-0606.

# CHAPTER 4

# RT-11 OPERATING SYSTEM

Application software packages for the 2511 and 2514 systems are designed to run under the Digital Equipment Corporation RT-11 single-user operating system for the LSI-11 controller. A subset of RT-11, called Run-Time RT-11, is supplied with the system, and is included on application program disks so that each one is a self-contained, ready-to-run package. Run-Time RT-11 provides a monitor which performs various services for the application programs, a device handler routine for the disk drive, and numerous utility functions that you will use for managing files on disks. This section gives a general description of the Run-Time RT-11 package, and of each of the functions available through RT-11 monitor commands.

For a demonstration of the use of RT-11 commands, refer to the detailed procedure in Chapter 3 for copying disks.

## 4.1 GENERAL DESCRIPTION OF RUN-TIME RT-11

The Run-Time RT-11 package (version V5.x) consists of a bootstrap loader, a monitor and device handler system programs, and some file management utility programs. These programs are supplied in the files which are listed and briefly described below. Some of these may or may not be present or may be replaced by similar files depending on the particular software package:

NOTE

The program files marked with an asterisk (*) are not applicable to the 2511/2514 systems and are not described in this manual. They are included only because the same software packages are used for larger GenRad 2502-2508 systems which use PDP-11 computers and may include additional peripheral devices.

| | |
|---|---|
| Bootstrap Loader | (not visible in directory) |
| SWAP.SYS | Reserved file area for monitor swap routines |
| RT11SJ.SYS | Single Job monitor |
| TT.SYS | Terminal device handler |
| DY.SYS | Double density floppy disk drive handler |
| DX.SYS* | Single density floppy disk drive handler |
| DL.SYS | Winchester (RL02) disk handler |
| RK.SYS* | RK05 disk handler |
| LP.SYS* | Line printer handler |
| RESORC.SAV | System Resource utility program |
| FORMAT.SAV | Hardware formatter program |

NOTE

FORMAT.SAV cannot be used with GenRad systems. To format floppy diskettes you must use the GenRad utility FORMGR.SAV.

| | |
|---|---|
| DUP.SAV | Device Utility Program |
| PIP.SAV | Peripheral Interchange Program |
| DIR.SAV | Directory reader program |

| | |
|---|---|
| SIPP.SAV* | Save Image Patch Program |
| STARTS.COM | GenRad indirect command file for startup |
| SYSINT.SAV | GenRad date and time routine and hardware initializer |
| TTCON.SAV* | GenRad utility for console terminal |
| TTAUX.SAV* | GenRad utility for auxiliary terminal |
| FORMGR.SAV | GenRad utility for formatting floppy diskettes |

### 4.1.1 Bootstrap Loader

The Bootstrap Loader actually consists of three parts: (1) A hardware bootstrap in ROM is activated by the main power or BOOT/HALT switches. (2) The hardware boot is capable only of loading the first block from the disk on drive #0 into memory. That first block contains a simple loader that reads the rest of the bootstrap from other fixed locations on the device. (3) The boot then loads the disk handler and the monitor programs. The boot also performs various analyzer initializing functions before turning over control to the monitor. The distribution disk(s) will have a bootstrap written on them. However, the bootstrap does not exist as a file. It is actually contained within the monitor file. When new system disks are created, the COPY/BOOT function must be used to extract the boot from the monitor file and write it into its assigned location at the beginning of the new disk.

### 4.1.2 Monitor Program File

The Monitor program file has several parts: a copy of the appropriate bootstrap for itself, the resident monitor (RMON), the keyboard monitor (KMON), and user service routines (USR). The resident monitor is loaded by the bootstrap and is always present in memory when the system is running. RMON provides various services for executing application programs and general management and arbitration for the various other components. RMON occupies about 2K of memory and resides at the highest usable locations of the first 32K of memory.

It is the keyboard monitor (KMON) that actually communicates with the operator via the prompting dot and the monitor command set. KMON allows the operator to request such functions as assigning logical names and calling programs to run (including the system utilities that are called by monitor commands). The user service routines (USR) provide various services for application programs, such as performing file operations. The KMON and USR segments are not necessarily resident. They will remain in memory if a loaded application program does not require their space. However, if the program does (and most GenRad application programs do), KMON and USR are swapped in only when needed. The area of the user program that they overlay is temporarily swapped out and saved on the RT-11 disk. This is why the reserved area represented by the file SWAP.SYS is required on the disk.

### 4.1.3 Device Handlers

The several device handler files are small routines that provide the hardware-mode communication with peripheral devices. They are normally called in by the monitor only when required. The only ones applicable to the 2511 system are the TT.SYS terminal handler and the DY.SYS handler for the double density floppy drive. Both of these must be present on your system disks.

### 4.1.4 Device and File Management Programs

The device and file management programs provide the support services necessary for maintaining and manipulating files on your disks. With the exception of SIPP, these programs and all of their functions are accessible through the keyboard monitor commands that are described in the rest of this section. The monitor translates these keyboard entries into a command string format that is acceptable to the utility programs. The monitor then loads and starts the appropriate program and passes the command to it for execution. Their general functions are as follows:

RESORC.SAV — Surveys and prints various system resource and configuration information for the monitor SHOW command.

FORMGR.SAV — Performs the disk hardware formatting operation described in the basic procedures of Chapter 3. (Applicable only to floppy drives.)

DUP.SAV — Performs device-related operations for the monitor commands COPY/DEVICE, INITIALIZE, COPY/BOOT, BOOT, SQUEEZE, and CREATE.

PIP.SAV — Performs file-related operations for the monitor commands COPY, TYPE, PRINT, RENAME, and DELETE.

DIR.SAV — Performs the several directory read and print operations under the monitor command DIRECTORY.

SIPP.SAV — Installs patches in binary program files. SIPP is not applicable to normal operation but might be used to install any future distributed patches, for which additional instructions would be supplied.

### 4.1.5 GenRad Utility Programs

GenRad utility programs provide miscellaneous functions unique to the 2511/2514 systems, as follows:

STARTS.COM — STARTS.COM is an indirect command file for startup. An indirect command file serves as an automatic operator. This command supplies alphanumeric command inputs just as they might be typed from the keyboard. Whenever the single job monitor is bootstrapped, the monitor searches the system disk for a file by this name and executes its commands. The STARTS.COM file that is supplied contains commands to set a monitor condition for video-type terminals and to RUN the following SYSINT utility. Usually, this file also contains the command to RUN the application program if there is only one on the disk.

NOTE

If the monitor does not find a STARTS.COM file, it prints the error message "KMON-F-Command file not found". This message can be ignored unless a STARTS.COM file was expected. This may occur if STARTS.COM is omitted from some of the working copy volumes. If it is not present, SYSINT should be always manually run to prevent problems from indeterminate analog input setups.

SYSINT — SYSINT is run by STARTS.COM to specifically request entry of a date and time and to set up some initial conditions in all analog input channels. If this is not done, channels that are not used by subsequent application programs would be left in an indeterminate state. This state allows them to drift up to high voltage levels that can interfere with input multiplexer operation. If STARTS.COM is not present to do this automaticallly, SYSINT should be manually run before running application programs.

TTCON
TTAUX — TTCON and TTAUX are only for larger GenRad systems which can have an auxiliary terminal installed.

## 4.2 DEVICE AND FILE IDENTIFICATION

### 4.2.1 Standard Physical Device Names

All devices supported by RT-11 have permanent physical device codes. These codes are recognized by the monitor and most of the application programs. The codes applicable to the system are listed below. Note that devices can also be referred to by logical names which can be assigned with a monitor command. If a unit number n is not given for multiple unit devices, unit 0 is assumed by default. Note that the colon (:) is part of the name and must always be included.

TT: — The terminal (keyboard in, display out).

DYn: — Double-density floppy disk drive.

SY: — The system unit from which the monitor was booted. This is actually a logical name. However, this name is always associated with the bootstrap device and cannot be assigned elsewhere. If it is a multiple unit device, SY: refers to whichever unit was specified in the boot and SYn: may be used to refer to other units.

DK: — The system default device and unit to which the system will refer if no dev: is indicated in a file reference. This also is a logical name. It is initially assigned to SY: when the system is booted, but can then be assigned elsewhere. DKn: refers to other units of the same device.

### 4.2.2 File Specifiers

Complete specification of a particular file consists of a file name, a file type, the device where it is or is to be located, and optionally for output files, space allocation in terms of device blocks (see next paragraph):

dev:filnam.typ(size)

File names may consist of 1 to 6 characters. File types consist of 0 to 3 characters. Both are alphanumeric only, that is they contain the letters A-Z and the digits 0-9. They do not contain symbols or embedded spaces. Names and types may be assigned as desired. However, the system uses certain type conventions and defaults, listed below, which should be observed. Note that the [size] argument is optional. If the argument is included, the square bracket characters are required. Also note this form of the [size] argument is restricted to command lines entered directly to file utility and application programs. When a size is to be given in a command to the monitor (. ), it must be specified with the /ALLOCATE:size option. This is noted in the command descriptions hereafter.

### 4.2.3 Defaults

If parts of the filespec are omitted, the system will assume or supply defaults as follows. Also note some special file type restrictions listed.

dev: The current system default device DK:. Initially, it is the same device as SY:, but it can be assigned.

filnam: The file name is normally not defaulted. It can be replaced by wildcards as described in the next paragraph. Some of the commands will assume one of those wildcards if no file name is given.

.typ The following file types are significant (as noted below) to Run-Time RT-11 and should be observed. Note that GenRad application programs, RANDOM, SINE and TSL in particular, assign and seek certain defaults of their own which are noted in the separate application software manuals.

**.SYS** is reserved for RT-11 system files. SYS files will not be included in most file operations unless they are specifically requested with a /SYSTEM option on the command.

**.BAD** file type is used to cover bad (unreadable) areas on disks. Files with this type are made permanently resident in their specific locations. This is done so that the bad blocks will not be reused. These files are not included in wildcard operations. The INITIALIZE function can be instructed to scan for bad blocks and to create files named FILE.BAD to cover them. An exception to the general rule about no duplicate file names is that more than one FILE.BAD can exist on the same device.

**.SAV** indicates a memory image (saved) program file that can be loaded and run. For example, DUP, PIP, and DIR, and GenRad application programs are all .SAV files. The monitor RUN command searches for .SAV files if a type is not specified.

**.COM** indicates an indirect command file for the monitor. Indirect files can supply commands to the monitor just like a keyboard operator. Whenever the single-job (SJ) monitor is bootstrapped, it automatically

searches for a command file named STARTS.COM. Such a file is usually provided on GenRad application disks. The purpose of this file is to request input of a system date, to initialize the analog to digital subsystem, and to automatically start the application program if there is only one on the disk. If a STARTS.COM file is not found on the booted disk, the monitor prints an error message ("Command file not found"). This message can be ignored. Command files are usually created via the RT-11 text editor. The text editor is not provided in Run Time RT-11. It is possible to create a simple COM file with TSL or with an RT-11 COPY function with TT: as the source "file".

**.DIR** is the default type that is assigned by the DIRECTORY function if its output is directed to a file instead of a printing device.

**.DAT** is a data file. This is not directly applicable to RT-11 operations. However, it is used as the default for several MODAL and application program outputs. Therefore, it may appear on some distribution disks that supply test data.

(size) Number of blocks to be allocated for a new file. See the paragraph on general file operations for default allocations and special symbols.

### 4.2.4 Wildcards

Several of the file manipulation commands will accept the wildcard symbols asterisk (*) or percent (%) to replace all or part of a file name or type. This allows the representation of several files in a single filespec expression.

The asterisk (*) can replace a file name, a file type, both, or any number of characters when embedded in file name or type.

Example:

| | |
|---|---|
| DY1:*.SAV | Means all files on device DY1 that have the type .SAV. |
| MYPROG.* | Means all files on the default device (DK:) that have the name MYPROG. |
| DY1:*.* | Means all files on device. |
| M*G.* | Means all files of any type on DK: whose file names begin with M and end with G. This would include MYPROG above. It would also include MG.*, MAG.*, MXXG.* and so on. |

The percent symbol (%) is an embedded wildcard for one character only.

| | |
|---|---|
| DY1:M%G.DAT | Means all files on DY1: of type DAT whose file names are three characters long and begin with M and end with G. This would include MAG.DAT, M2G.DAT, and so on. It would not include MYPROG or MG as above. |

The commands that will accept wildcards are listed below along with the defaults they assume if no wildcard symbols are supplied:

| Command | Input Default | Output Default |
|---|---|---|
| DIRECTORY | DK:*.* | not applicable |
| COPY, RENAME | *.* | *.* |
| TYPE, PRINT | *.LST(N/A for Run-Time) | always TT: or LP: |
| DELETE | filnam.* | not applicable |

Examples:

COPY DK: DK1: all files from default dev: to default dev: unit #1

COPY *. TSL DY1:*.* all .TSL files from DK: to DY1 retaining their original names

DIR list all files on DK:

DIR DY1:*.TSL list only .TSL files from DY1:

COPY MYSUB DY1: all files named MYSUB, regardless of type, from DK: to DY1:, retaining their names and types. Equivalent to: COPY DK:MYSUB.* DY:*.*

Some combinations, which will usually be obvious, are illegal and will be refused. However, it is possible in some cases to delete files by mistake. Therefore, always check the use of wildcards carefully. The DELETE command normally requests confirmation for each file of a wildcard operation. COPY and RENAME do not request confirmation unless told to do so. While the latter two do not affect the original file, they might delete another file if duplicate names occur on the output device. See the general operation rules and the /NOREPLACE option.

## 4.3 DEVICE DIRECTORY, AND FILE ORGANIZATION

### 4.3.1 Blocks

All information on an RT-11 random access device (i.e., disk) is organized and accessed by the operating system in software blocks of 256 16-bit words, regardless of the device type. This does not necessarily correspond to the physical organization of the device. Floppy disks, for example, have sectors of a track (hardware blocks) that contain only 128 or 256 bytes of data. Nonetheless, data is written and read on these disks by software that deals in 256-word blocks. File sizes and relative locations in directories are in terms of 256-word blocks. Therefore, all further reference herein is in terms of 256-word software blocks. Note that all sizes in blocks and starting block numbers (file addresses) are stated in decimal. This is the way sizes are listed in directories unless the /OCTAL option is specifically invoked in commands.

### 4.3.2 Bootstrap

Blocks 0 and 2-5 of a device are reserved for the bootstrap loader for a particular monitor on that device. Except for the bootable initial distribution disks, the COPY/BOOT function must be used to read the appropriate bootstrap out of a monitor file and write it into this area. This must be done before the disk can be started by hardware boot. A bootstrap can also be written on a new device by the COPY/DEV function. Both of these have been demonstrated in the previous section and are described further in the paragraph on device manipulations with DUP.

### 4.3.3 Volume Identification

Block 1 of the device is reserved for a volume ID and owner's name (12 characters each). These may be assigned or changed with the INITIALIZE function. Block 1 also contains a code indicating that the device is in RT-11 format plus some additional code information for the operating system.

### 4.3.4 Directory

The Directory begins in block 6. For the operating system, directories are organized in "segments". Each segment occupies two blocks. A segment contains a few words of directory information for the system and space for 72 file entries. DY floppies normally have four segments, blocks 6 through 13, providing space for up to 288 file entries. This theoretical limit can be reached by packing disks. However, because of the way the directory segments are handled by the system, the practical limit is usually about half of the maximum (approximately 150 entries). The default directory size can be changed when the disk is first INITialized. For example, the directory size can be made larger if hundreds of small files are expected. Conversely, the size can be made smaller if only a few large files are expected and maximum space for data is desired.

### 4.3.5 Directory Entry

A directory entry consists of seven words which contain the following information for a file:

- File Status can be permanent (closed), tentative, or empty never used or deleted.
- File Name and Type
- File Date
- File Size in blocks used
- File Address (starting block number) which is actually determined indirectly from a starting point and the file sizes.

Tentative and empty areas also have directory entries indicating their sizes and locations. These areas are listed as (UNUSED) in /FULL directories.

## 4.4 GENERAL NOTES ON FILE OPERATIONS

RT-11 uses a contiguous file structure. That is, a file must always occupy consecutive blocks on the device from its beginning to its end. There is no linking of a file from one area to another.

When a device is initialized, the directory area is created and cleared. This makes the entire device (UNUSED) and available for new files. The INIT function just changes statuses to (UNUSED). It does not actually erase any data from the disk. Therefore, if a copy of the previous directory exists, it is possible to recover files from an accidentally INITed disk by recreating directory entries. However, this is a difficult process and is not fully described herein. There is also an INIT/RESTORE option that can recreate the previous directory as long as no new files have been written.

As files are written to the disk, they are assigned consecutive areas and consecutive entries are made in the directory. When files have been deleted, empty areas will be created.

When a new output file is to be created, it will initially be allocated a space equal to one-half the largest available area on the device or all of the second largest area, whichever is larger. A size can be specified in blocks with the (size) argument or /ALLOCATE option. In this case, the file will be located in the first area large enough for the file. The special code -1 for size will allocate all of the largest area.

A tentative directory entry is made for a new file in the appropriate location with the file name, type, and date. The current system date is used if it is a new file and if the system is dated. The date of the source file is used for a COPY operation unless the /SETDATE option is specified. In this case, it will assign the current system date for the output file.

Note that a tentative entry may have the same name and type as a permanent file on the same device unless the /NOREPLACE option is invoked to protect against this. If this is done, the new entry will be refused with a warning message. If this is not done, the old file will be deleted when the new one is closed.

The file is thus opened and the write-to-file operation can proceed until the program is through with it or until the allocated space is filled. In the latter case, a warning message will be supplied and the operation will not be completed. That is, the file will not be closed unless the operator does so with a monitor .CLOSE command. When the operation is successfully completed, the file is closed automatically by the RT-11 utilities and most GenRad application programs.

Closing a file reduces its size from the space allocated to the space actually used, changes the directory status from tentative to permanent, and deletes any previous file with the same name and type.

Deleting a file does not erase any data nor the directory entry. It merely changes the status from permanent to empty. This makes it appear as (UNUSED) in directories and makes its space available for use by new files. The deleted file continues to exist until the area actually is reused. Its directory information can still

be obtained with the special /DELETED option of the DIRECTORY command. Thus, an accidentally deleted file or any remaining portion of it can be recovered as long as it has not been written over by new file data.

NOTE

A tentative entry in the directory must always be followed by an unused entry. This is done to account for any remaining space when part of the allocated area is not re-used. Therefore, the system does a lot of pushing down of directory entries to allow for these unused entries as deleted areas are reused. This is part of the reason why only about half of the theoretical maximum number of directory entries is available in normal usage.

## 4.5 PROMPTING AND COMMAND CHARACTERS

The following characters are output as prompters for input:

. Keyboard monitor is ready for a command entry.

* Utility or application program is ready for an entry.

The monitor recognizes the following single (or combination) keystroke characters as commands. CTRL/x means hold CTRL key and strike x key.

RETURN Terminator and execution command for all operator entries.

CTRL/C Terminates program execution and returns control to the keyboard monitor for command input. Two CTRL/Cs will be required if the system is not already looking to the keyboard for input. Echoes ^C and (. ).

CTRL/U Deletes current input line and echoes CR-LF to allow re-entry on next line. This function is also provided by the ERASE LINE key if it is present on the keyboard.

DELETE or RUBOUT. These functions are provided by the BACKSPACE key. Deletes the last character of the current line for each BACKSPACE. See the notes on Error Erase state in the terminal description.

CTRL/S Stops operations that are outputting to the terminal. Essentially the same as a terminal busy or page full condition.

CTRL/Q Resumes terminal output from the point where it was stopped. No output is lost. Essentially the same as a ROLL or HOME key command after a page full.

CTRL/O Suppresses terminal output but allows program to continue. Toggles on/off. Output between CTRL/Os is lost. Cancelled by CTRL/C.

## 4.6 MONITOR COMMAND SYNTAX

### 4.6.1 Command Line Format

The monitor will accept commands in either long or short form. The long form is where only the command (and /options) is entered and the monitor prompts for the rest of the information. The short form is where all command information is entered on a single line. Where (CR) indicates RETURN and (SP) indicates one SPACE, these two general forms are as follows:

Long Form, with prompts:

```
COMMAND(/option/option/etc(CR)
PROMPT1?input(from)filespec(/option)(CR)
PROMPT2?output(to)filespec(/option)(CR)
```

Short Form, one line:

```
COMMAND(/option)(SP)in-file(/option)(SP)out-file(/option)(CR)
```

Options that apply to a particular file, such as /ALLOC:size or /BEGIN (with file), must be associated with the filespec. Options that apply to the whole command can usually appear anywhere in the command line. In a few cases noted in the descriptions which follow, these options must be associated with the command word. If the long form is used, the command options must be on the first line. For example:

```
.DIRECTORY DY1:/FULL/BLOCKS
```

is correct, but in long form it must be:

```
.DIRECTORY/FULL/BLOCKS
File?DY1:
```

### 4.6.2 Abbreviations

The monitor commands and options are all English language words and may be spelled out fully in a command line. They may also be abbreviated to as few characters as will distinguish the command to the monitor. For example, ASSIGN may be abbreviated to AS, since that is enough to distinguish it from any other command that begins with A. DEASSIGN requires three characters (DEA), since DE could also be DELETE. The monitor will issue a warning message if a command entry is ambiguous. As a general rule, four characters is always sufficient. The options that begin with NO may require six characters such as NOREPL for NOREPLACE.

### 4.6.3 Factoring

More than one input filespec, separated by commas, can be specified for several of the commands. Such commands can be shortened by factoring. That is,

using parenthetical expressions to associate one part of the filespec with several specifications of another part. For example, the command line:

COPY DY1:FILEA.DAT,DY1:FILEB. DAT,DY1:FILEC. DAT DY0:

can be factored to

COPY DY1:FILEA.DAT,FILEB.DAT,FILEC.DAT DY0:

or even

COPY DY1:FILE(A,B,C).DAT DY0:

In the second line, device DY1: applies to all the expressions in parentheses. Complex factoring of the form (DY0,DY1):FILE.(TSL,DAT) is not allowed and certain other combinations will be rejected with error messages.

## 4.7 MONITOR COMMAND DESCRIPTIONS AND FUNCTIONS

The following paragraphs describe the commands and options for functions available from the monitor. The command set is subdivided by paragraph for the utility programs that perform each function. This is done because there are several of the options that are common to various commands within a particular utility. A summary list of all the monitor commands in alphabetic order is given in Appendix A.

### 4.7.1 Direct Monitor Functions

Except as noted for SHOW, the commands described in this paragraph are performed within the monitor itself. They will allow .REENTER to a resident program when they are done. The commands listed on the second line are not normally used in GenRad systems. However, they are available from the run-time RT-11:

**DATE,TIME,ASSIGN,DEASSIGN,SHOW,R,RUN,CLOSE,REENTER**

**LOAD,UNLOAD,INSTALL,REMOVE,RESET,GET,START,B,E,D,SAVE**

DATE dd-mmm-yy

GenRad application package disks usually include a startup command file that requires entry of date. This monitor command may be used if the date during file management operations is to be changed. Typing DAT without arguments will print back the current system date (if any).

TIME hh:mm:ss

NOTE

The RT-11 TIME function is listed here only to point out that it is not available in the 2511/2514 VCS. It requires additional line clock hardware for the LSI-11. The time entry that is requested by the SYSINT startup routine is for the GenRad 2501 microprocessor. That time is used by some GenRad application programs, but cannot be set or read by the RT-11 TIME command.

ASSIGN dev: nam:
and
DEASSIGN nam:

These commands allow a logical name of up to three characters to be given to either of the disk drives. After the first assignment above, floppy drive #1 can be referred to as device FIL: in file specs. After the second assignment, DY1 becomes the system default device as well. Any subsequent filespecs that do not include a device will refer to DY1. The first deassignment simply removes the FIL name from DY1. The second removes default code DK from DY1. The second also restores DK to the system device SY where it is initially assigned when the system is booted. A DEASSIGN with no arguments removes all logical names from all physical devices (except DK for SY). Note that more than one logical name can be assigned to the same device. A logical name can only be assigned to one device at a time. Therefore, assigning a name to one deassigns it from any others. The system device logical name SY cannot be assigned to any other, nor are the names BA, FG, or EL allowed. These names have special meanings for other capabilities of full RT-11.

SHOW (no arguments)

This command will list all of the peripheral devices known to the running monitor with the status of their handlers (i.e., "resident" or "loaded"). It will also show any logical names that may have been assigned to them.

NOTE

The utility program RESORC.SAV must be present on the system volume. A previously resident program cannot be REENTERed after SHOW. RESORC provides several other options for SHOW, none of which are applicable to the 2511 configuration.

R filespecifier
and
RUN dev:filespecifier

These commands load and start memory image program files. The default file type is .SAV. The R command can be used only for programs on the SY system device. RUN must be used for any other device.

CLOSE (no arguments)

This command closes (makes permanent) any open tentative files. It is not used in normal operation. It may be useful to save partial files that were not completed because of unexpected program termination.

REENTER (no arguments) This command restarts a resident program (for those that allow it), without clearing or resetting any memory areas. REEN restarts the basic program but does not continue operations that were in progress. REEN will not be allowed after exits caused by errors that may have corrupted necessary conditions. An illegal command message will be returned.

NOTE

None of the following direct monitor functions has any normal use in the analyzer. They are listed and very briefly described here only because they are available from the monitor. Some of them may be used to install patches in existing programs. If so, additional instructions would be supplied.

LOAD dev:(,dev:,dev:)
and
UNLOAD dev:(,dev:,dev:) The first command makes the device handlers for the indicated devices permanently resident below the resident monitor. Conversely, the second command removes them.

INSTALL dev:

REMOVE dev: These two commands modify the internal device table of the monitor (the one listed by SHOW) to make it aware that additional or special devices and handlers exist in the system. No use in normal systems.

RESET (no arguments) This command does a general cleanup of the user program area. It purges input/output (I/O) channels, unloads device handlers, and reinitializes conditions for the user program area. It can be used if the monitor or a device needs initialization (not same as INITIALIZE command) before execution. It can also be used to cancel the effect of a preceding GET. Not used in normal GenRad operations.

GET filespecifier This loads a memory image program file (default type .SAV) without starting it. It can be used with B, E, D, START, and SAVE for modifying and testing programs. The RUN command above is a combination of GET and START.

START (address(octal,even)) Starts a resident program at the address specified or at the normal transfer address of the program if none is given.

| | |
|---|---|
| B [address(octal,even)] | Base. Sets a relocation base address for the following Examine and Deposit commands. Address default is 0. |
| E address(octal,even) [-address] | Examine. Prints the content of the specified address (relative to the relocation Base if one was entered) or of all addresses inclusive if a first-last combination is given. |
| D address(octal,even)= value[,value,value,etc.] | Deposit. Writes the value into the address given (relative to the relocation Base if one has been entered). Multiple values are written into successive addresses. |
| SAVE filespec address [-address2 [,address3] -address4] | Writes a memory image file (default type .SAV) of the memory area(s) specified by the addresses given. Used to save copies of programs that have been modified by means of Deposit commands while they were in memory. Not used for normal GenRad system operations. |

### 4.7.2 Hardware Formatting Function (FORMGR.SAV Program)

NOTE

The standard RT-11 format utility (FORMAT.SAV) cannot be used with GenRad systems. To format a disk, use the program FORMGR.SAV.

Floppy disks must be formatted to be used in double density on DY drives. The basic format function has been described in detail in the initial operating procedures of Section III. However, the FORMAT command has additional options which are described under the general command form below. Note that reformatting and/or verifying can frequently restore bad blocks on a disk.

**CAUTION**

FORMAT irretrievably destroys any previous data on the disk.

To start FORMGR.SAV, enter the following

```
.R FORMGR
Device: ___
```

**FORMAT [ /options ] dev:**
**/[ NO ]) QUERY**
**/SINGLEDENSITY**
**/VERIFY[ :ONLY ] [ /PATTERN:value)]**
**/WAIT**

| | |
|---|---|
| NOQUERY | The FORMAT function normally prints the warning query "dev:/FORMAT-Are you sure?" before proceeding with the operation. The /NOQUERY option suppresses this message. |
| VERIFY[:ONLY] | Verification is a process of writing and reading a specified bit pattern to and from every word on the disk. It is used mainly for investigation of hardware problems but sometimes will restore bad blocks. If the :ONLY option is not specified, the disk is also |

reformatted before verification. :ONLY suppresses formatting. Note that verification is also a data destructive process. Neither process should be used on a disk that contains anything wanted. If the /PATTERN option below is not given, verify uses pattern #8.

PATTERN:value — Value is an octal integer in the range 0-377 indicating which of the patterns listed below is to be used. The default, if /PATTERN is not given, is #8. PATTERN:0 runs #1. PATTERN:25(octal) runs #1, 3, and 5. PATTERN:377(octal) runs all eight.

| Bits Position Set | Pattern | #16-bit Pattern (octal) |
|---|---|---|
| 0 | 1 | 000000 |
| 1 | 2 | 111111 |
| 2 | 3 | 163126 |
| 3 | 4 | 125252 |
| 4 | 5 | 052525 |
| 5 | 6 | 007417 |
| 6 | 7 | 021042 |
| 7 | 8 | 102410 |

/WAIT — This option is provided mainly for the benefit of systems with only one disk drive. However, it may prove useful on occasion. The /WAIT option causes the monitor to fetch the utility program and initiate the funcion. It then pauses before execution to allow a different volume to be substituted on the device specified in the command line. At the pause and upon completion, it prints messages and a query for the operator to respond Yes when ready; e.g., "Mount volume you wish to format. Continue?" (Yes).

### 4.7.3 Device Manipulation Functions (DUP.SAV Utility Program)

The following listed monitor commands are performed by the Device Utility Program (DUP). These commands have to do with special operations on devices as opposed to file operations:

**INITIALIZE COPY/BOOT COPY/DEV BOOT SQUEEZE CREATE**

**INITIALIZE(/options) dev:**
**/(NO)QUERY**
**/VOLUMEID(:ONLY)**
**/SEGMENTS:n**
**/BADBLOCKS(:RETAIN)**
**/WAIT**
**/RESTORE**

The INITIALIZE function is required for all new disks before they can be used by RT-11. It may be used to "clear" a used disk for reuse. On a new disk, INIT creates a directory setup so the disk can be used. On a used disk, it changes the status of all existing files. This change is such that the entire disk appears to be <UNUSED> and is available for writing new files.

**CAUTION**

With the single exception of the /VOL:ONLY option, INIT effectively destroys any files already on the disk. It does not actually erase any data or directory entries. However the change of file status makes it difficult to recover files (at least after any new ones have been written). If the analyzer is accidentally INITed, the /RESTORE option can be used to cancel the mistake as long as no new files have been written.

/NOQUERY—INIT — normally requests confirmation with the query "dev:/Init are you sure?". This requires entry of a Yes response to continue. The NOQUERY option suppresses that confirmation message.

/VOLUMEID(:ONLY) — This option allows entry of a volume identification and owner's name of up to 12 characters each, for which it will prompt on following lines. The :ONLY option can be used to change volume ID on a used disk without re-initializing it. The ID can be read with a DIRECTORY command option.

/BADBLOCKS(:RETAIN) — This option causes INIT to scan the device for bad blocks. If any are found it will write files named FILE.BAD over them. This prevents their use in subsequent normal file operations. If bad blocks are found in the bootstrap or directory areas, the device is unusable and a fatal error message is printed. If you wish only to scan for bad blocks on a used disk without initializing, use the DIRECTORY/BAD function. If the :RET option is appended to the /BADBLOCKS option, the INITIALIZE function will not perform the bad block scan. However, it will retain any FILE.BAD files from a previous INIT. This saves the time required for bad block scan without losing previously found bad blocks when a disk is re-INITed.

/SEGMENTS:n — INIT uses a default value to establish the number of directory segments on a disk; i.e., the size of the directory. This option can be used to increase or decrease the space allocated. See the paragraph on device and file structure. Note that n is segments, each of which is two blocks. Each has a maximum capacity of 72 entries per segment.

/WAIT — This option is mainly for systems with only a single disk. When it is used, the system will enter the INIT operation. It will then pause and print an instruction to mount the volume that is to be INITed. Upon a Yes response, it then proceeds. When done, it prints another instruction to remount the system volume.

This page intentionally left blank.

/RESTORE

This option "uninitializes" a volume, restoring the directory to its condition prior to the last INIT. This allows recovery of a volume that was accidentally INITed. However, RESTORE can only be used if no files have been written on the volume since it was last INITed. Also note that /RESTORE does not restore the bootstrap blocks. If this function was performed on a system disk, the bootstrap blocks must be rewritten with the COPY/BOOT command. RESTORE is only to recover from an accidental INIT. It does not restore files that were previously DELETED.

**COPY/DEVICE(/options) dev:(/options) dev:(/options)**

| | | |
|---|---|---|
| **/FILE** | **filespec** | **filespec** |
| **/NOQUERY** | **/START:n** | **/START:n** |
| | **/END:n** | |

COPY/DEVICE

is an absolute block-oriented function, as opposed to the file-oriented COPY function under the PIP program described in the next paragraph. In its basic form with no options, it simply copies the input device block-by-block to the output device. It will produce an exact duplicate of as much as will fit on the output. For example:

.COPY/DEV DY0: DY1:

This mode copies all data from the input device such as the bootstrap and volume ID blocks, the directory, the files, and even the unused areas. This is useful for making duplicate disks, provided that there are no bad blocks on the output device and that the devices have the same number of physical blocks. If bad blocks are encountered in the input, an error message is printed. However, the operation is retried. If only one error message is printed, it may be assumed that the copy was successfully completed. If the devices have different numbers of blocks, the operation proceeds until the smaller one is exhausted or filled. However, although this function will operate between different size devices, it is not recommended. Invalid directories may result. For example, a COPY/DEV from a single density diskette (such as a GenRad software distribution diskette) to a double density diskette will operate. However, the resultant output disk will appear to have only about 480 blocks and the remainder of its 960-block capacity is not usable.

The COPY/DEV function has additional options for more flexibility. These options are to copy specified areas or to copy between a device and a file (or vice versa) as follows:

/NOQUERY

Since COPY/DEV is destructive of existing data on the output device, it normally prints the confirming query "dev:/COPY; Are you sure?" This query must be answered with a Yes response. This option suppresses that query.

| | |
|---|---|
| /START:n, /END:n | These options must be associated with the device specifiers rather than the basic command. They make it possible to copy a specified portion of the input device to a specified area of the output device. The decimal block number on the device is n. |
| /FILE, with a filespec | This option allows copying of the image of a device or portion thereof to be stored in a named file on another device, and the reverse. |

**COPY/BOOT dev:monfil.SYS dev:**

Before a volume can be hardware booted as a system device, the bootstrap routines must be written into their fixed locations in device blocks 0 and 2 through 5. The distribution disks have bootstraps appropriate for the system device. For all subsequent copies of system volumes this function must be used to make them bootable from the front panel. This command extracts the bootstrap information from the monitor and device handler file for the target device. This information must already be present on the target volume. The information is written into its assigned blocks.

Example:

```
COPY/BOOT DY1:RT11SJ.SYS DY1:
```

A subsequent boot of this device will load the monitor whose name was given in this command. All monitors supplied by GenRad have the name RT11SJ. However, it is legal to change the monitor name if desired. In that case, a device bootstrap would boot whichever name was given in this command when the boot was copied onto the device. The BOOT command described below can be used for a "software boot" of a specific monitor file regardless of the boot written on the volume. Since the boot is taken from the device handler for the device specified as the target, it will always correspond to that device. That is, if writing a boot on a DY device, the volume can only be booted from a DY device.

**BOOT[/options] dev:[monfil.SYS]**
**/WAIT**

This command, given from a running monitor, reboots the system with a new monitor. If only a dev: is specified, it performs a "hardware" boot. It bootstraps the monitor whose boot has been written in blocks 0 and 2 through 5 of the volume by the preceding COPY/BOOT command. If a monitor file name is given, it performs a direct boot of that file and does not use the hardware boot blocks. This latter mode was intended mainly for full RT-11 where different versions of the monitor might reside on the same volume. Note that this also makes it possible to boot from a volume that has not had a boot written on it. Assigned logical device names may be used in place of physical device names. The date and time are preserved across this command boot, whereas they are not for a front panel boot. The options are:

/WAIT — This option is intended mainly for systems with only a single disk. It loads and initiates the operation. It pauses with a query to remove the system volume, replace it with a different one, and responds Yes to continue the boot.

**SQUEEZE (/options) dev:**
**/NOQUERY**
**/WAIT**
**/OUTPUT:dev:**

As the system is used and files are created and deleted, disks will become fragmented with many small unused areas. The SQUEEZE operation compresses all files to the beginning of the disk. It consolidates all unused blocks in one area. It may also happen that a directory becomes full when there is still room on the device. The directory has not reached its maximum capacity as described in the paragraph on general file operations. A squeeze operation also compresses the directory and makes room for more entries. SQUEEZE does not move files with type .BAD. If any exist, the space before each one is used only as long as the next complete file will fit into it. When the next file will not fit, an unused area will be left and the next file will be located after the .BAD file.

**CAUTION**

It is essential that files not be moved into areas with bad blocks. If this were done, it could result in no usable copy. Always use DIR/BAD to scan for bad blocks before a SQUEEZE. If any are found in unused areas, use CREATE to write FILE.BADs over them. Preferably, the disk should be backed up before a SQUEEZE. The /OUTPUT:dev: option shown below then may be used. If bad blocks are found in existing files, the monitor will report an error. The monitor will abort if the error persists through a retry.

SQUEEZE does not affect the bootstrap blocks. If the current system volume is squeezed, the monitor will be automatically rebooted at the end of the operation. This is done to prevent possible crashes if .SYS files were moved from their previously known locations. The options are:

/NOQUERY — SQUEEZE normally prints an "Are you sure?" query and requires a Yes confirmation. NOQUERY suppresses this message. NOQUERY is also the normal mode for the /OUTPUT option.

/WAIT — This option is mainly for single disk systems. It allows squeezing disks other than the system disk. It initiates the operation, but then pauses with instructions for the operator to mount the volume to be squeezed, and then remount the system volume. This cycle may have to be repeated several times.

/OUTPUT:dev — This option leaves the input volume unchanged. It copies all the files to the output volume in squeezed format. This is essentially the same as the wildcard copy of all files used in Section III to duplicate disks. The only exception is that for SQUEEZE the output volume must be newly INITALIZEd (i.e., empty). It is not necessary to use the /SYS option to include .SYS type files. SQUEEZE does not copy .BAD files and it does not copy the bootstrap blocks.

**CREATE filnam.typ(/START:n(/ALLOCATE:n))(/EXTENSION:n)**

This function creates a file by either making a directory entry for it or extending the size of an existing file. It does not store or alter data in the new area it covers. It is frequently used in conjunction with the /DELETED option of DIRECTORY to recover files that have been accidentally deleted. If options are not specified, it will start the file in the next available space and allocate one block or extend by one block. CREATE is not allowed if the new or extended file would overlap any existing files. Note that all the options must be associated with the filespec rather than the command word.

/START:n — This option specifies the starting block number (in decimal) for absolute location of new files. Starting blocks of existing files and empty areas can be obtained with the /BLOCKS and /FULL options of DIRECTORY.

/ALLOCATE:n — This option specifies the size of the file in blocks (decimal). If n is not given, 1 is assumed.

/EXTENSION:n — This option specifies the size of the extension for existing files in blocks (decimal). If n is not given, 1 is assumed.

### 4.7.4 File Manipulation Functions (PIP)

This paragraph describes the commands that operate on files as opposed to the preceding device operations. All of these functions call on the PIP utility program. They are:

COPY TYPE RENAME DELETE

Several of the available options in this group are common to all or more than one of these functions. The common options are described below and then just listed in the command descriptions afterward. Options that are unique to one command are described under that command. Note that all of these commands will accept wildcard designations to operate on a category or set of files.

/SYSTEM — System files (type .SYS) will not be included in Copy, Rename, or Delete operations unless this option is specified.

/SETDATE — The existing date on an input file is normally carried through a Copy or Rename operation. If this option is specified, the date for the output file will be changed to the current date unless the system is currently not dated.

/NEWFILES — If this option is invoked the operation will be performed only on the files specified. It will also be performed only on those that bear the current system date. That is, it will be performed on the files created "today".

/(NO)REPLACE — The system is normally allowed to open a new file with the same name as an existing one. It will then delete the old one when the operation is successfully completed. The NOREPLACE option will prevent the operation if a duplicate name is specified.

/(NO)QUERY — The delete command normally prints a list of files to be deleted. It requests confirmation (?) by Yes entry for each of the files to be deleted. This confirmation request can be suppressed by /NOQUERY. Conversely, the COPY and RENAME operations do not normally request confirmation for each file. However, they can be instructed to do so by /QUERY. This allows the operator to selectively copy or rename only certain files from a wildcard group.

NOTE

/QUERY above and /LOG below are normally mutually exclusive. For DELETE, the normal query list supplies a log. For COPY, the normal log appears unless /QUERY is specified. If both query and log are wanted, it must be so indicated in the command with /QUERY/LOG (or just /LOG for DELETE which will always query unless instructed otherwise).

/(NO)LOG — The COPY and RENAME commands normally print a log of the files involved if there is a wildcard in the filespec and if /QUERY is not specified. It can be suppressed with /NOLOG. DELETE normally prints only a query list. However, a log can also be requested with /LOG.

/EXCLUDE — For COPY and DELETE. This option instructs the system to operate on all files on a device except the ones specified in the input filespec.

Example:

```
COPY/EXCLUDE *.SAV,*.DAT DY1:*.*
```

will copy all files from the current default device to floppy DY1 except for image (program) files .SAV and data files .DAT. .SYS and .BAD files are also never included unless specifically requested.

/WAIT — This option is intended mainly for systems with only a single disk drive. When a command is invoked with the /WAIT option, the system will load the appropriate utility and initiate the function. The system then stops and prompts with a message to replace the system volume with the input and/or output volumes to be operated on. When ready, respond Yes to a "Continue?" query. If operating on a single device, the input/output swap may have to be repeated several times. When the operation is complete, another message instructs the system volume to be remounted. The only time the /WAIT option is absolutely required in a dual disk system is when it is desired to copy files between disks, neither of which has the system programs.

### 4.7.5 Commands, Options, and Defaults

Listed below are the commands of this group. This is followed by a list of their options with descriptions of the ones not covered above. Options listed on the same line are mutually exclusive. Options separated from others by a blank line must be used alone. Others may be combined in the command as desired. The default options that will be assumed if others are not specified are underscored. No operation will be performed that would result in deletion of a protected file. For example, even if /REPLACE is specified in a COPY command, the operation would not be performed if a protected file of the same name exists on the target device. Protection is assigned or removed only by the RENAME command.

**COPY[/options] input-filespecs output-filespec[/ALLOCATE:size]**

| | |
|---|---|
| **/SYSTEM** | **(include .SYS files)** |
| **/SETDATE** | **(assign current system date)** |
| **/NEWFILES** | **(include only current system date)** |
| **/[NO]QUERY** | **(confirmation request)** |
| **/[NO]LOG** | **(list copied files for wildcards)** |
| **/EXCLUDE** | **(all except input filespecs)** |
| **/[NO]REPLACE** | **(delete old file if duplicate)** |
| **/WAIT** | **(initiate, then pause for volume swap)** |
| **/CONCATENATE** | |
| **/PREDELETE** | |
| **/SLOWLY** | |
| **/IGNORE** | |
| **/DEV** | **See preceding paragraph on device operations (DUP)** |
| **/BOOT** | **See preceding paragraph on device operations (DUP)** |

The COPY function reads the input file(s) and writes it (them) into new output files. Up to six input file specs may be listed, separated by commas, and/or wildcards may be used. Only one output filespec is allowed. It may contain name or type wildcards but no embedded wildcards. If wildcards are used in input, the corresponding name or type in output must be a wildcard. The only exception is the /CONCATENATE option. The output filspec must represent a single file. Therefore, no wildcards are allowed. Type .SYS files will not be copied unless /SYS is specified.

Type .BAD files will not be copied unless they are specifically identified by filnam.BAD. The function will preserve the date of the input file for the output, delete any old files with the same name as the new output after the operation, and print a log listing if wildcards are involved.

Example:

.COPY A%B.DAT DY1:*.BAK

This copies from the default device all files of type .DAT whose names have three characters beginning with A and ending with B to floppy drive DY1. The copies will have the same names. However, their types will be changed to .BAK (backup).

**CAUTION**

This use of output wildcards could delete any files on DY1: named A%B.BAK unless /NOREPL is used to guard against it.

The unique copy options are:

/CONCATENATE — Normally each input file is copied to a separate output file. If /CONC is specified, all input files will be concatenated into a single output file. This concatenation will be in the order in which they are listed and/or found on the device. The filespec of the single output file cannot contain any wildcards. Concatenation can also be specified without /CONC by using plus signs instead of commas to connect the input files, e.g.:

COPY A.DAT+B.DAT+C. DAT DY:XYZ. DAT

/PREDELETE — If this option is specified, an existing file with the same name as a new output file will be deleted before the copy is performed. This option can be used on crowded devices to recover space for new files provided they will fit where the old one was.

**CAUTION**

If errors occur in the operation, you may be left with no usable copy.

/SLOWLY — This option performs the copy operation one block at a time. It can sometimes perform an operation that previously failed because of read errors.

/IGNORE — This option forces the block by block copy of SLOWLY. It also instructs the system to ignore any input errors. It can sometimes recover files that are otherwise unreadable and allows the operation to proceed even if errors still occur.

/ALLOCATE:size — This option specifies the number of blocks to be initially allocated for each output file. The special size code -1 will allocate all of the largest contiguous area. Note that in this monitor command form the size must be specified with /ALLOC. It cannot be given as a (size) suffix on the filespec.

**TYPE(/options) input-filespecs**

| | |
|---|---|
| **/(NO)LOG** | **(list copied files)** |
| **/QUERY** | **(confirmation request for wildcards)** |
| **/NEWFILES** | **(current system date only)** |
| **/WAIT** | **(start, then pause for volume SWAP)** |
| **/COPIES:n** | |
| **/DELETE** | |

The TYPE function is merely a special case of COPY which is intended only for ASCII files and direct output to the TT: terminal. If a .typ is not given in the filespec, the default is type .LST (for "listing"). Type .LST files do not normally occur in application software. The unique options are:

/COPIES:n — Specifies n = 2 to 32 (default 1) repetitions for multiple copies.

/DELETE — Deletes the file after it is printed. CAUTION: No confirmation queries.

**RENAME (/options) input-filespecs output-filespecs**

| | |
|---|---|
| **/NEWFILES** | **(current system date only)** |
| **/(NO)REPLACE** | **(delete old duplicates)** |
| **/QUERY** | **(confirmation request)** |
| **/(NO)LOG** | **(list renamed files)** |
| **/SETDATE** | **(change date to current system date)** |
| **/SYSTEM** | **(required for .SYS files)** |
| **/WAIT** | **(start, then pause for volume swap)** |
| **/(NO)PROTECT** | **(see below)** |

This function assigns a new name and/or type to an existing file. It operates only on the directory entries and does not tamper with the file data. Otherwise, it follows the same general rules as the preceding COPY operation and its options. Up to six input filespecs can be listed but only one output. For wildcard operations, RENAME normally prints a log listing of the files. This listing may be suppressed with the /NOLOG option or replaced with /QUERY for selective renaming. The dev: for input and output must be the same. Renaming from one device to another cannot be done. The /SYS option must be given to operate on .SYS type files. Files that are .BAD will not be included in an operation unless identified explicitly by name and type. If a file already exists with the same name as the new (output) name, the old file will be deleted unless /NOREPL is specified or it has protected status as follows:

/(NO)PROTECT — These options assign or remove protected status for a file. A protected file cannot be deleted by a DELETE command or by creating a new file with the same name. Protected status is indicated by a P following the file size in directory listings. Protected status is carried through COPY and/or RENAME operations. It can only be removed by the specific RENAME/NOPROTECT option.

**DELETE(/options) filespecs**

| | |
|---|---|
| **/(NO)QUERY** | **(confirmation request)** |
| **/LOG** | **(list deleted files)** |
| **/NEWFILES** | **(current system date only)** |
| **/EXCLUDE** | **(all except those specified)** |
| **/SYSTEM** | **(required for .SYS files)** |
| **/WAIT** | **(start, then pause for volume swap)** |

This function deletes files (up to six filespecs, and wildcards) by changing their directory status from permanent to empty (UNUSED). Thus, it makes their space available for new files. Accidentally deleted files can be recovered until the space is re-used. DELETE follows the same general rule and options as COPY and RENAME. The only exception is that its default condition is to request /QUERY confirmation instead of printing a log unless /NOQUERY is specified. If /LOG is specified, confirmation will not be requested unless /QUERY is also specified. Files .BAD will not be deleted unless they are identified explicitly by name and type. .SYS files will not be deleted unless the /SYS option is included.

### 4.7.6 Directory Operation (DIR.SAV Program)

All of the functions of the DIR.SAV program are called through the single basic command DIRECTORY with several options described below. These functions merely read and output information about existing (or deleted) files. None of these functions alters anything on the device. If filespecs are specified in the command, the system will list directory information only for those files (or groups of files if a wildcard is used). This is true except for the /EXCLUDE option which lists all files except those specified. Up to six filespecs may be specified. If only a device is specified, the directory will include all files on that device. If not even a device is indicated, the directory will list all files on the DK: default device. If no options are requested, the default output is printed on the terminal in two columns, reading across, in the order in which files are physically located on the disk. Each listing will show file name and type, size in 256-word blocks, protected status (if applicable), and date, if any. The size, and block number address when requested, are normally printed in decimal. However, they can be requested in octal. The basic command form and options are as described below. Some of the options are mutually exclusive in certain combinations that will be obvious when attempted:

**DIRECTORY[/options] filespecs[/BEGIN]**
**[/TERMINAL/PRINTER/OUTPUT:filespec[/ALLOCATE:size]]**
**[/VOLUMEID[:ONLY]] (print ID and owner, if any)**
**[/EXCLUDE] (list all files except "filespecs")**
**[/BEFORE:dd:mmm:yy] (files prior to date only)**
**[/SINCE:dd:mmm:yy] (files after date only)**
**[/ORDER:category (:NAME, :TYPE, :DATE, :SIZE, :POS)[/REVERSE]]**
**[/SORT:category[/REVERSE]] (same as ORDER)**
**[/ALPHABETIZE[/REVERSE]] (same as ORDER:NAME)**
**[/COLUMNS:n] (print in n = 1-9 columns, default 2)**
**[/BRIEF] (print only filnam.typ, 5 columns)**
**[/FAST] (same as BRIEF)**
**[/BLOCKS] (include start block numbers)**
**[/OCTAL] (print size and block in octal)**
**[/FULL] (include (UNUSED) areas)**
**[/FREE] (list (UNUSED) areas only)**
**[/DELETED] (list only deleted and tentative files)**
**[/WAIT] (start, then pause for volume swap)**
**[/BADBLOCKS[/FILES][/START:n][/END:n][/VERIFY]]**

/BEGIN — This option must always be associated with the filespec. If given, the directory will include only the specified file and all that are physically after it on the device, in position order. Other ORDERs cannot be specified with this option.

/TERMINAL
/PRINTER
/OUTPUT:filespec [/ALLOC:size] — The directory is normally printed on the terminal. It can be directed to a line printer if available or to an output file itself. In this case, the size allocation in blocks can be specified. The default type if not given is .DIR.

/EXCLUDE — List all files on the device except those indicated by the specified filespecs.

/NEWFILES
/BEFORE
/DATE
/SINCE — These four options are mutually exclusive. /NEWFILES lists only those with the current system date. Note that the dates for these options are entered with colons(: ) rather than hypens (-) as they are for the monitor .DATE command. The ranges are dd = 1-31, yy = 73-99, and first three characters for the month. Any part of the date may be defaulted. If no date is given, the current system date is assumed. If only a day is given, it is assumed that day of the current date month and year. If only a month is given, it assumes the first day of that month in the current year. If only a year is given, it assumes 1 JAN of that year. If the system is undated, it is considered date 0. This is the same as an undated file entry in the directory. /NEWFILES is the same as /DATE[defaulted].

/ORDER:category — The directory listings will be printed in the order specified by one of the following categories. (Numbers come after letters in alpha listings.):

| | |
|---|---|
| :NAME | Alphabetical by filnam, then alphabetical by type for same names |
| :TYPE | Alpha by type, alpha by filnam for same types |
| :DATE | Oldest file first, alpha for same dates |
| :SIZE | Smallest file first, alpha for same size |
| :POS | (Default) physical position on device but see note below. |

/REVERSE may be applied to any of the above. /SORT is an alternate name for /ORDER, and /ALPHA is a shorter entry for /ORDER:NAME.

NOTE

For all of the ORDER options (including defaulted :POS), multiple columns read top to bottom rather than across as for the default case.

/COLUMNS:n — This option will normally be used to change the default 2 columns to 1. More than 2 won't fit on the screen or thermal printer.

/BRIEF/FAST — These options are the same. They print only the filnam and .typ, always in five columns, omitting size and date.

/BLOCKS — This option includes the absolute starting block number for each file. This is done to indicate the physical location of the file on the device. It is useful in recovery operations for accidentally deleted files. Block numbers are in decimal unless the following /OCTAL option is invoked.

/OCTAL — Prints the file sizes and block numbers in octal instead of decimal. This is helpful where a function requires an octal address.

/FULL — Includes listings of the (UNUSED) areas between files.

/FREE — This option gives a list of (UNUSED) areas only. With this option, sizes of the ones remaining can be quickly seen.

/DELETED — This option prints the directory information for files that have been deleted but have not had their directory entries destroyed by re-use of their areas. Tentative (unclosed) files are also included. The block numbers are always included in both decimal and octal. This can be useful in re-creating accidentally deleted files with the DUP CREATE function.

NOTE

If several contiguous files have been deleted, the /DELETE option may list only the first file name with a size. This size includes the entire area of all the contiguous files.

/BADBLOCKS
{/FILES}{/START:n}
{/END:n}{/VERIFY}

This option scans a volume for bad blocks. Unlike the INIT/BAD function, it does not INITIALIZE the volume nor write FILE.BAD over bad blocks. It can be performed on a volume that has been in use to detect bad blocks that may have developed from age or misuse. If any blocks return hardware errors when they are read, DIR/BAD prints a list of their absolute block numbers in both decimal and octal.

/FILES

If the /FILES option is included, the list will also include the names of files in which the bad blocks are located.

/START:n
and
/END:n

The /START:n and /END:n options allow you to limit the range of the scan by giving starting and ending block numbers, n, in decimal. The defaults are block 0 (the first block on the device) and the last block on the device.

/VERIFY

The /VERIFY option carries the scan one step further. Instead of just reading the block for a checksum, the scan will read the block, write the same data back to it, and read it again. The block may sometimes recover. If it does, it will report a "soft" error. However, this still does not guarantee the integrity of the data in the block. Therefore, /VERIFY should be used only after a failure and should be regarded with caution.

# APPENDIX A

## ALPHABETIC SUMMARY OF MONITOR COMMANDS AND OPTIONS

```
ASSIGN dev: nam:

B [address(octal,even)]   (Base for Examine and Deposit)

BOOT [/options] dev:[monfil.SYS]
       /WAIT

CLOSE     (no arguments)

COPY/BOOT dev:monfil.SYS dev:

COPY/DEVICE/[options] dev:[options] dev:[options]
            /FILE           filespec      filespec
            /NOQUERY        /START:n      /START:n
                            /END:n

COPY[/options] input-filespecs output-filespec[/ALLOCATE:size]
       /SYSTEM
       /SETDATE
       /NEWFILES
       /[NO]QUERY
       /[NO]LOG
       /EXCLUDE
       /[NO]REPLACE
       /WAIT
       /CONCATENATE
       /PREDELETE
       /SLOWLY
       /IGNORE

       /DEV        (Listed separately above)

       /BOOT       (Listed separately above)

CREATE filnam.typ[/START:n[/ALLOCATE:n]][/EXTENSION:n]

D address(octal,even)=value[,value,value,etc.]   (Deposit)

DATE dd-mmm-yy   e.g., DAT 6-JAN-80

DEASSIGN nam:
```

```
DELETE(/options) filespecs
        /(NO)QUERY
        /LOG
        /NEWFILES
        /EXCLUDE
        /SYSTEM
        /WAIT

DIRECTORY(/options) filespecs(/BEGIN)
              /TERMINAL/PRINTER/OUTPUT:filespec(/ALLOCATE:size)
              /VOLUMEID(:ONLY)
              /EXCLUDE
              /NEWFILES
              /BEFORE:dd:mmm:yy
              /DATE:dd:mmm:yy
              /SINCE:dd:mmm:yy
              /ORDER:category(:NAME,:TYPE,:DATE,:SIZE,:POS)(/REVERSE)
                /SORT:category(/REVERSE)
                /ALPHABETIZE(/REVERSE)
              /COLUMNS:n
              /BRIEF
              /FAST
              /BLOCKS
              /OCTAL
              /FULL
              /FREE
              /DELETED

              /BADBLOCKS(/FILES)(/START:n)(/END:n)(/VERIFY)

E address(octal, even)(-address)   (Examine specified address)

FORMGR(/options) dev:
        /(NO)QUERY
        /SINGLEDENSITY
        /VERIFY(:ONLY)(/PATTERN:number(octal 0-377))
        /WAIT

GET filespec

INITIALIZE(/options) dev:
          /(NO)QUERY
          /VOLUMEID(:ONLY)
          /SEGMENTS:n
          /BADBLOCKS(:RETAIN)
          /WAIT
          /RESTORE

INSTALL dev:
```

```
LOAD dev:[,dev:,dev:,. . .]

R filespec

REENTER  (no arguments)

REMOVE dev:

RENAME[/options] input-filespecs  output-filespecs
          /NEWFILES
          /[NO]REPLACE
          /QUERY
          /[NO]LOG
          /SETDATE
          /WAIT
          /[NO]PROTECT

RESET  (no arguments)

RUN dev:filespec

SAVE filespec address[-address2][,address3[-address4]]

SHOW  (no arguments)

SQUEEZE[/options] dev:
          /NOQUERY
          /WAIT

          /OUTPUT:dev:

START  [address(octal,even)]

TYPE[/options]  input-filespecs
      /[NO]LOG
      /QUERY
      /NEWFILES
      /WAIT
      /COPIES:n
      /DELETE

UNLOAD  dev:[,dev:,dev:,. . .]
```